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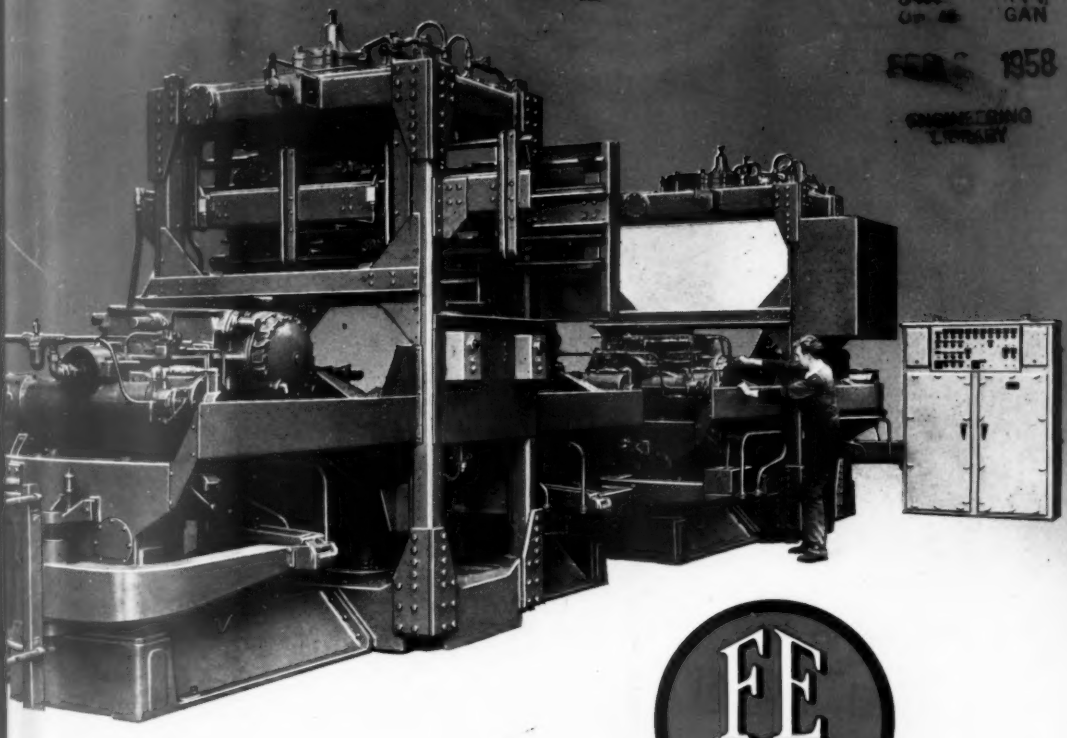

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PRINCIPAL CONTENTS

Page

Metallurgical Aspects of Hot-tearing in Cast Steel

by Kurt Beckius

The article comprises abstracts from a Paper presented in Stockholm last year, and which contained important new data on the solidification process and the formation of hot-tears in steel castings. 115

Craft Apprentices' Corner: Open-sand Moulding (with "Tubal Cain" on the Job!)

This, the first of a series of articles intended for the guidance of younger entrants to the industry, comments in "down to earth" language on some of the practical problems of open-sand moulding. 125

Cupola with Continuous-slit Tuyeres

by A. A. Anan'in and B. P. Chernobrovkin

Abstracted from a Russian journal, the article reports on a new tuyere system in which the blast is introduced through peripheral slits, and comments on the advantages claimed for this method over that in current use. 129

Features:

Leader: A Productivity Report .. 113
Correspondence: "Cupola Growing?" .. 114
Equipment and Supplies .. 124
Notes from the Branches .. 128
Book Reviews and Publications Received .. 132
Forthcoming Events .. 135

News, Commercial Information, and Statistics

ABBF London-area Notes .. 114
Cocktail Party .. 114
Not Much Out of the Ordinary! .. 127
BTH Annual Review .. 130
American Letter .. 130
India to Make Power Tools .. 130
Company News .. 131
Contracts Open .. 131
News in Brief .. 133
Personal .. 136
Raw Material Markets .. 138
Current Prices of Iron, Steel and Non-ferrous Metals .. 140

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A Productivity Report

Philology has advanced somewhat since the early post-war days, so that what would then have been called a productivity report is now designated a study of automation. Under this newer title comes an excellent one-man report, "Automation in North America."* It is by Mr. S. B. Bailey of the (UK) Department of Scientific and Industrial Research, and has not suffered at all from recording individual views instead of the collective impressions of a group. On the contrary, information garnered by a trained scientific observer is in many ways of greater import than that recorded by individuals of a group having their own practice uppermost in mind. For example, the author points to the general system in vogue in the USA, of operating two shifts and leaving the interim period for plant maintenance.

Throughout this report, there are many references to foundry production, and we are told that the iron foundries in American motor-car plants are technically very far in advance of those in the UK; their productivity per man/hour is sometimes five times greater for components of similar size and design. They often produce more defective castings—which are reclaimed by welding—but the extra production takes care of this extra work. Earlier reports have stated that much of the fettling work has been eliminated by leaving the removal of flash and adhering sand to heavy-duty shotblast machines. Shell production is extensively used, Mr. Bailey states, for valves, valve rockers and cylinder-bore cores. One firm is shell moulding all its crankshafts in nodular-graphite cast iron, but here, coring has sometimes given place to full machining, as is done with steel forgings. The crankshafts are said to be less costly despite the fact—and this is perhaps contrary to British experience—that nodular-graphite cast iron is reported in the States to be less costly to machine than forged steel.

The report envisages that the future will see great increases in productivity due to the wider use of light-alloy die-castings. Already, it had been announced that one firm had been successful in making complete six-cylinder engine blocks of an aluminium alloy on a new 72-in. die-casting machine which could utilize dies weighing up to 50 tons and could produce 30 and 35 blocks per hour—with a very great saving in manpower—compared with a normal grey-iron block.

The report covers quite a number of activities, and the making of pipe-fittings comes in for consideration. Here, there is a description of a shell-moulding foundry producing valves and fittings up to 2-in. bore in brass and steel. No fewer than 1,400 shell moulds are produced daily on a rotary-table machine developed by the Walworth Company in conjunction with the Link Belt Company. The machine is described as entirely automatic; it is fed with mixed sand from a hopper and shells are unloaded to a buffer store by one man, who also acts as inspector. In this store, pairs of biscuits are suspended by wire hooks from axially rotating and very slightly inclined bars. They then feed down automatically to the end of the store, where they are removed as required. One half is placed on an open conveyor, where a synthetic-resin cement is extruded on to the joint-face through a plastics hose. Meanwhile, the cope is passing along a parallel conveyor which takes it through an electric oven, heating the component to 105 deg. C. The two conveyors terminate opposite a turntable, which carries aluminium boxes with hinged lids, each box and lid containing an inflatable rubber bladder. The two half-moulds are placed on top of one another in the box, the lid is closed by hand and a clasp fixed. Air pressure is then applied to the bladder and by the time the moulds reach the far side of the turntable, the cement is set. At a second turntable, two moulds are placed in a bucket, where they are automatically backed by $\frac{1}{8}$-in. steel shot. The pouring conveyor is synchronized with a mould conveyor and the ladles containing the metal are suspended from an overhead monorail and move freely, with the pourer standing on his moving platform. The buckets are automatically tipped at a knock-out station, where the shot is screened and returned by air blast to an overhead hopper located above the turntable. The sand is not recovered. A second, less-highly-mechanized, plant is employed on making steel castings for valve bodies and here, 3 per cent. of red iron-oxide is added to the resin/sand mix, to improve the surface finish of the castings.

The foundry of the Cincinnati Milling Machine Company was visited by Mr. Bailey at the suggestion of the British Cast Iron Research Association and it was noted there that young engineers work in pairs, one being at the university and one in the works—which is thought to

* Published by H.M. Stationery Office, York House, Kingsway, London, W.C. ; price 4s. net.

A Productivity Report

be an improvement on the British part-time day-release system, as the works is never short of a man. This company is a licensee of the International Meehanite Corporation and makes the usual additions of calcium silicide and some calcium carbide to the metal in the ladle. It produces modular-graphite cast iron by a Meehanite process, adding magnesium/ferro-silicon to the ladle. It was said that no other Patent royalties were involved. The iron produced is a low-manganese, high-silicon material, which is partly ferritic as cast, but contains sufficient pearlite to enable components made from it to be flame-hardened where necessary. It is interesting to note that a zirconia- or fine-silica-based wash for cores and moulds was being widely used, as the moulders preferred to get "dirty" with a white powder rather than with a black one.

The exerpts we have culled from this Report give some appreciation of its interesting contents and we counsel its acquisition by all those dreaming of the near future when the European market—with its 350-million inhabitants—will be open to them.

ABBF London-area Notes

The Association of Bronze & Brass Founders held a meeting for London area members at the Clarendon Restaurant, Hammersmith, in December, under the chairmanship of Mr. W. R. Buxton. A report was given on current activities of the Association, and topics discussed included the Thermal Insulation Act; conditions in non-ferrous foundries; liaison with associations with similar interests; the International Foundry Apprentice Competition; the European Committee of Foundry Associations; revision of British Standard 1400; inspection procedure; the technical advisory and research group; technical talks and papers to be given at future meetings.

In connection with the last point, it was decided that in the event of a member-firm experiencing difficulty in certain foundry techniques, the secretaries would arrange, in conjunction with the technical committee, for a qualified speaker to deal with the matter at an area meeting. It was hoped at the next meeting to devote time to a discussion on the Association book "Costing and Casting," which is to be published in the next month or two. Another suggestion to be followed up was for a symposium to be organized on fettling methods.

Latest Foundry Statistics

Copper-base Castings: During November last year the foundry industry produced 6,916 tons of copper-based castings. This information comes from the monthly *Bulletin* of the British Bureau of Non-ferrous Metal Statistics. The total for the first eleven months of 1957, at 70,697 tons, is 357 tons lower than that recorded for 1956.

Correspondence

CUPOLA GROWING?

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—We have been very interested to read your comments on page 70 of the January 16 issue of the JOURNAL, under the above heading, concerning the increased capacity of cupolas being installed in this country. Whilst we would agree that there has been an increased demand for larger cupolas in recent years, we are not convinced that this is proof of a definite trend towards larger cupolas, as replacements of worn-out existing plant must be taken into account.

Of far more interest, in our opinion, is the increasing appreciation shown by foundrymen of the advantages to be gained from modern mechanical charging and stockyard equipment, the value of which increases as melting plants increase in capacity. Whilst the labour-saving advantages of mechanical handling plant *inside* the foundry are widely known and appreciated, the mechanical handling of cupola charge materials has not, in our opinion, received sufficient attention, yet with careful design very considerable reductions are possible in the labour force required for operation of cupolas.

As an example we would mention a particular layout which our company has developed and which permits the whole of the operations involved in charging a cupola, *i.e.* preparation of metal, coke and limestone charges to be made by one man. The equipment concerned provides automatic weighing of materials, relieves the operator of the responsibility of ensuring accurate charges, completely dispenses with hard manual work, ensures continuous accurate records to the foundry management of materials used and costs, and almost completely eliminates the risk of accidents within the stockyard and charging areas. The layout can be applied to furnaces of any known capacity.

It will be obvious, when considering the labour force that would usually be required to charge, say, a 20-ton per hour cupola, that the particular layout indicated, using *one man only*, represents an enormous saving in labour costs alone, apart from the other advantages which automatically follow from precise control over charging operations. We are convinced that in this field the United Kingdom is abreast of current practice, and certainly in the case of the layout mentioned above we are ahead of most other countries.—Yours, etc., for Constructional Engineering Company, Limited,

J. H. GRAINGER,
Sales Manager.

Titan Works,
Charles Henry Street,
Birmingham, 12.
January 20, 1958.

Cocktail Party

On Tuesday, January 21, the South of England Ironfounders Association under the chairmanship of Mr. M. J. Glenny held a cocktail party for members and guests, in London. By courtesy of the Honourable Company of Master Mariners, this took place on board the Wellington, the headquarters of the Company, moored in the Thames off Temple Stairs, Victoria Embankment. Between 30 and 40 participated, including guests from the Midlands and Merseyside, and the opportunity of inspecting this interesting vessel, with its valuable models of ships of all ages, formed an interesting sidelight to the quite informal proceedings. The function was arranged by Mr. G. B. Judd the secretary.

Metallurgical Aspects of Hot-tearing in Cast Steel

By Kurt Beckius

Mr. Kurt Beckius was born in 1928 and graduated as Met. M. from the Royal Institute of Technology, Stockholm, in 1954. He is at present research metallurgist at Jernkontoret, Stockholm.

The study of hot-tears in steel is naturally of immediate interest to foundrymen and the following comprehensive abstracts have been made from an important contribution to the literature of this subject which was presented at last year's International Foundry Congress in Stockholm. The Author reports in detail on the results of casting experiments made in an apparatus designed on the resistance-spring principle. The resulting curves for time/contraction relationships were compared with the occurrence of tearing as manifested in macro-etched, tear-containing sections of cast test-bars. The contraction-restraining load imposed on the specimens was removed at different time intervals after pouring, and data collected were further supplemented by temperature measurements during the cooling and solidification. An attempt is made to explain the relationship between the solidification process and hot-tear formation, and in this the Author differs in a number of respects from the theories postulated by Pellini[1] and his associates.

Experiments

Apparatus and Methods

The Author conducted extensive experiments into the formation of hot-tears in steel and for his study utilized an apparatus of the kind described by Lange & Heine[2]. The method consisted of measuring the longitudinal change in a cast test-bar which was prevented from contracting during solidification and cooling by a spring of such strength as to cause possible hot-tear in the bar. The bars were cylindrical and of section thickened towards one end. This section solidified more slowly than the main portion of the bar and thus any tear formation was localized. It proved advisable to make certain modifications both in the design of the specimen and of the apparatus in order to adapt the equipment to the conditions encountered in the casting of steel. The final design is illustrated in Fig. 1.

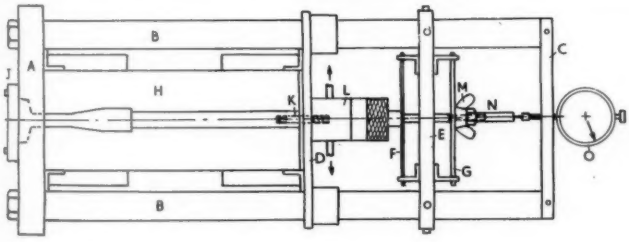


FIG. 1.—*Hot-tear testing apparatus with cope-half of the sand mould lifted away.*

The mould cavity for the bar (H) continues into the base plate (A) of the apparatus in the form of a steel chill in two detachable halves which are kept in position by a small plate (J) on the outside of the base-plate. At the other end of the cavity a steel bolt (K) threaded at both ends passes in to a distance of about 25 mm. The resistance spring (G) is held in position by a wing nut (M). By rapid release of the wing nut the spring load can be removed at the desired instant. The scale of the dial gauge (O) is graduated in 1/100 mm. with 100 divisions per revolution of the pointer.

The sand moulds were rammed by hand in a wooden box with wooden pattern. The mould material consisted of silica sand (AFS Number 140) with the addition of 1.5 per cent. linseed oil, 2.5 per cent. of a proprietary cereal binder and 5.0 per cent. water.

To prevent the liquid steel from running out in the parting between the two halves of the mould and forming shifts which would disturb the contraction process, it was necessary to dry the mould with the parting surfaces in contact.

To prepare the apparatus for casting, a ring of modelling clay was pressed in between the bolt (K) and the wall of the mould to a depth of about 1/5 inch. This prevented the steel from running out between the bolt and the mould wall. The mould was weighted with a piece of iron. A ring-shaped sand core placed immediately above the gating in the upper half of the mould was used as pouring cup. Pouring was done direct from the furnace.

Metallurgical Aspects of Hot-tearing

Test-bars Used

Different types and sizes of test-bar were tried out. The type which gave the most reproducible results is illustrated in Fig. 2. It is hereafter called type A. Tears arising in this test-bar are largely situated on the envelope surface of a right circular cone with its base in the cross-section at which the thin and thick sections of the bar meet. The apex of the cone is in the thicker part of the bar, and the generatrices of the envelope surface usually form an angle of 45 deg. with the base.

Experiments were also made with test-bars having a conical transition between the thin and thick sections. If the transition was sufficiently gradual, tears no longer occurred in the region where the smallest section started but instead near the gate as shown in Fig. 2. In casting a bar of uniform thickness, in which the gating served as hot spot, tearing occurred on the same places as in type-B bars. The gating system, which, with the pouring cup, serves as a feeder, is cone-shaped and is dimensioned to prevent shrinkage-cavities from arising either in the tear region or in other parts of the test-bar.

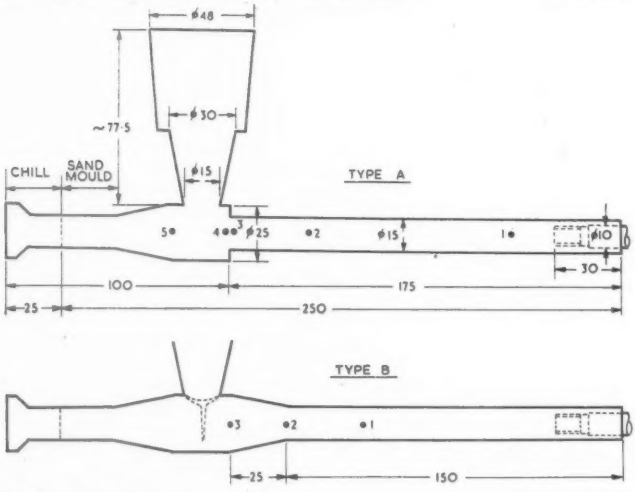


FIG. 2.—*Test-bars, types A and B. The numbers* 1-5 *and* 1-3 *along the bars indicate temperature-measuring points.*

Melting and Pouring

The steel was melted in a basic high-frequency induction furnace with a 110-lb. charge capacity. Clippings containing C 0.05 per cent.; Si 0.01; Mn 0.40 Mn and very small quantities of P, S and other impurities, were used as starting material. Carburizing was done with pig-iron containing about 4 per cent. C and low impurities. Additions of silicon and manganese were made in the form of ferro-silicon (75 per cent.) and manganese metal (99 per cent.). When the influence of steel composition was not the main object of investigation, the composition of the melt was maintained within the following limits:—C 0.21 to 0.27, Si 0.35 to 0.45, Mn 0.75 to 0.85, P 0.010 to 0.020, and 0.015 to 0.025 per cent.

The mean carbon-content of all samples cast with this composition, hereafter known as standard composition, was 0.24 per cent. When the object of the experiment was to investigate one of the composition components, the remainder were retained within the above limits.

Seven to nine specimens were normally cast from each melt. Deoxidizing with silicon was done in two stages, the first in conjunction with the addition of pig-iron and manganese after the scrap had melted, the second immediately prior to the first pouring. The silicon content was also regulated by small additions between pourings.

The temperature of the steel bath was measured with immersion pyrometer before each pouring. For test-bars of standard composition the measured bath temperature was maintained at 1,598 ± 2 deg. C., corresponding to superheat of about 85 deg. C. in relation to liquidus in the iron-carbon diagram of Fig. 3. The same excess temperature of 85 ± 5 deg. C. was used in experiments with other carbon contents.

Curve Characteristics and Calibrations

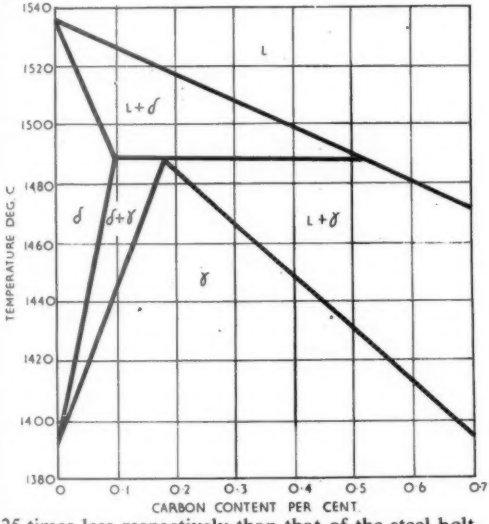
When casting test-bars of the types under consideration, the ends of the bar cooled and solidified very rapidly owing to the effect of the base-plate and the steel bolt inserted in the mould cavity. On the remaining parts of the bar a thin coherent skin of solidified metal would be expected to form more or less simultaneously. Owing to the continued cooling this skin started to shrink immediately, as observed on the dial gauge. By reading off the meter every sixth second from the start of pouring, curves were produced as shown in Fig. 6a. Whereas similarity existed between the initial portions of practically all the curves, up to about 16 sec. (denoted by the interval I), the subsequent portion was characteristic of a specimen of standard composition, the contraction of which was prevented by a 5.2-mm. thick spring.

The pouring time was about 3.5 ± 0.5 sec., but already within 0.5 to 1 sec. after the start of pouring the pointer deflected in the direction indicative of expansion. The magnitude of the deflection varied from specimen to specimen. A conceivable explanation of this varying movement of the pointer that there was a certain thermal expansion of the steel bolt in the end of the test-bar. The bolt was ad-

mittedly water-cooled, but naturally the portion within the test-bar could not be prevented from becoming heated. To determine the possible influence of thermal expansion, some experiments were made in which the steel bolt was replaced by a quartz tube or a bolt of "Kovar" (Fe/Co/Ni alloy containing about 20 per cent. CO and 28 per cent. Ni). In these experiments the resistance-spring was removed, so that the measurements referred to the free contraction, which proved more reproducible than the restrained contraction.

The curves were exactly similar with all three materials (Fig. 4). The divergences shown by individual points of measurement were within the limits of the experimental errors and could not be interpreted as due to the different coefficients of expansion of the materials. Thus the dilatation process was not changed when the steel bolt was replaced by a Kovar bolt or a quartz tube, the coefficients of expansion of which were about 6 and

FIG. 3.—*Part of the Fe/C equilibrium diagram.*

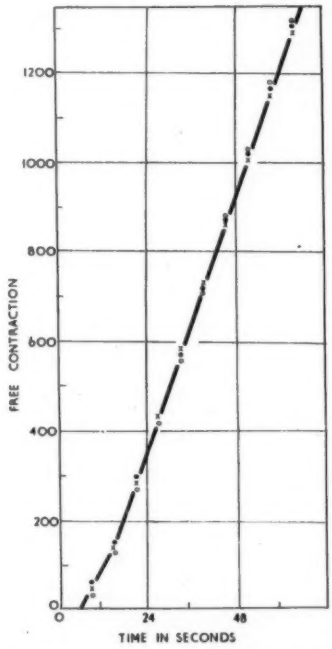


25 times less respectively than that of the steel bolt. This shows that, if thermal expansion had any influence—which is conceivable before continuity conditions arose between the heated and cooled parts of the bolt—it did not affect the character of the subsequent course of the curves. It has not been possible to determine whether the effect of impact of the poured steel contributed to the expansion movement. Since a displacement of the starting point caused by impact would hardly affect the subsequent contraction process, no particular attention was paid to this possibility. Consequently, bolts of carbon steel were used thereafter.

The maximum deflection of the pointer usually occurred 5 to 6 sec. after the start of pouring, marking incipient contraction. About 10 sec. later the rate of contraction increased sharply. The free contraction thereafter was a straight-line function at a rate of about 1.4 mm. per min. for about 1 minute, whereas the curve of the restrained contraction deviated during the same interval both in magnitude and direction to an extent dependent both on the strength of the spring and on the form of the test-bar. The magnitude of the stresses arising in the test-bar were governed by the strength of the spring, the choice of which was therefore an important question. For this reason castings were made with five springs of different thickness and the following loading characteristics:—

Spring thickness, mm.	3.0	4.0	5.2	5.7	7.0
Deformation, μ per kg.	19.2	10.0	5.6	4.0	2.3

The deformation of the 5.2-mm. thick spring, 5.6 μ per kg., corresponds to 1.0×10^{-4} in. per lb., a value used by Middleton & Protheroe and Lange & Heine.



x = steel bolt. ● = "Kovar" bolt. o = quartz tube.

FIG. 4.—*Free-contraction curves from tests with test-bar, type A, standard composition and* 1,600 *deg. C. pouring temperature.*

The results with the cast test-bars of type A, standard analysis and 1,600 deg. C. pouring temperature, are given in Fig. 5. As can be seen, the curves were of generally similar shape. After the rate of contraction had reached maximum, there were two breaks in the curves: the first when the contraction rate fell again, the second when contraction ceased altogether. The time from the start of pouring until the slopes of the curves changed, and the increase in contraction during that time, decreased with rising spring force.

Metallurgical Aspects of Hot-tearing

Steel Composition and Pouring Temperature

In the subsequent experiments on test-bar type A with 5.2 mm. spring a study was made of the influence of various steel compositions and pouring temperatures on the process of deformation. It was found that the shape of the curves changed in one or more respects for certain values of some of these variables. The various characteristic types of curves produced are shown in Fig. 6 (*a-f*). Each curve was based on measurements from 10 to 30 tests, each of which resulted in the same shape of curve but with somewhat differing absolute values. The latter may be considered to lie within ± 10 per cent. in time and ± 20 per cent. in spring deformation.

The process from the start of pouring until the full rate of contraction was reached will hereafter be designated interval I, the subsequent portion up to the first break interval II, The final portion, interval III, usually contained two more or less different slopes, here named α and β. The location of the break between intervals II and III varied somewhat from one type of curve to another. The limits in time were 22 and 30 sec., and in deformation of the spring 150 and 250μ.

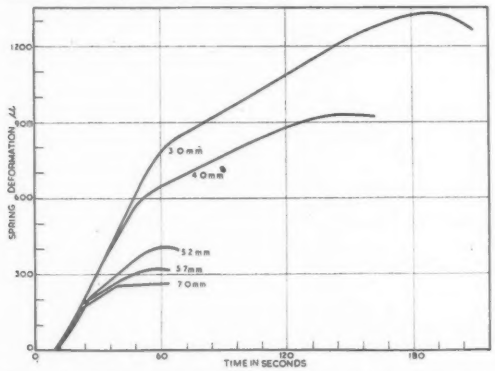


FIG. 5.—*Time/contraction curves with different springs. Curves corrected to the same zero level.*

Fig. 6 (*a*) shows the type of curve, which hereafter will be called standard curve, resulting from experiments on test-bar type A, standard composition and 1,575 to 1,650 deg. C. pouring temperature. At a higher pouring temperature, 1,650 to 1,695 deg. C, the curves were as shown in Fig. 6 (*b*). In comparison with the standard curve, they were characterized by a very much lower rate of contraction after the break between intervals II and III followed by a higher rate in the interval IIIβ (50 to 70 sec.). The contraction thereafter fell off again. The difference in rate of contraction between intervals II and IIIα was greater, the higher the pouring temperature.

At the lowest pouring temperatures tested, 1,575 to 1,565 deg. C., the curve instead changed in the respect that the break between intervals II and III became less distinguishable and that the subsequent portion of the curve became rounder (Fig. 6 (*c*)). In addition, the rate of contraction within intervals II and III was considerably greater than in the standard curve.

Experiments with 0.03 per cent. C. produced a more rectilinear curve than the standard curve (Fig. 6 (*d*)), the difference in rate of contraction between intervals II and III being small, in addition to which the rate of contraction at the end of the latter interval rose again to roughly the same value as in interval II. The curve straightened out also at 0.41 per cent. C. (Fig. 6 (*e*)), but its later portion implied a slightly diminishing rather than increasing rate of contraction. Curves of specimens with very low manganese content showed a sudden break within interval III, where the contraction was nearly zero or even changed to expansion (Fig. 6 (*f*)). The tears were there so serious that rupture occurred, especially at the lowest contents. The same effect was found in steel with high phosphorus or sulphur content.

Experiments with elevated phosphorus and sulphur contents were also made on steel containing 0.30 per cent. C. The latter curves, however, did not differ from those for low-carbon steel with normal phosphorus and sulphur contents.

The addition of a sufficient quantity of aluminium to steel of standard composition produced curves of roughly the same shape as at the lowest pouring temperature.

A closer study of the implication of the shape of the curves and their various parts in respect to tearing and tear-susceptibility was therefore considered a matter of interest. For this purpose series of test-bars were cast in which the load from the resistance spring was removed after varying lengths of time. The tearing process was then studied in sections of the tear region, and at the ame time the relation of the tears to the solidification structure and its associated phenomena were investigated.

Character of Tears and Structure

On no occasion were tears found in any part of the test-bars type A other than the region already indicated. Small pieces, 1¼ to 2 in. in length, were sawn out of the tear region, the cut being made along the length of the bar. This section, in which the tears stood out as the two sides of an equilateral triangle, was duly prepared, macro-etched and studied in respect to the relation between the size, direction, appearance and primary structure of the tears. A study of the character of the tears, both in the periphery of the bar and in cross-sections at different distances from the junction, revealed that the behaviour of the tears in the studied longitudinal section was representative of all longitudinal sections in the bar.

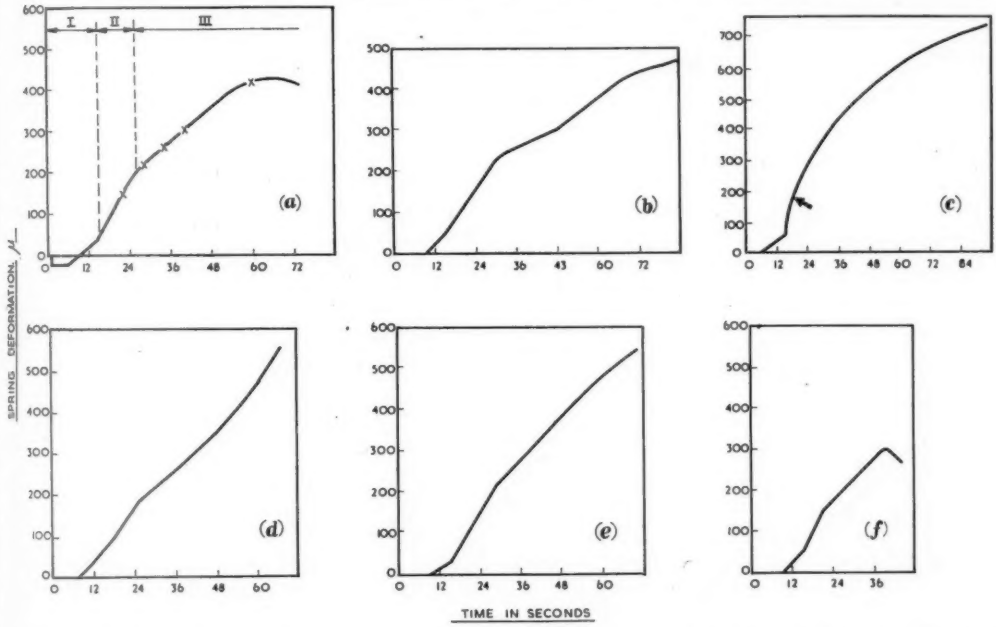
To bring out the macrostructure clearly, and avoid disturbances from the microstructure, the samples were quenched and tempered before further preparation in accordance with directions given by Magnusson.[3]

The freezing structure in a bar of these dimensions, cast in a sand mould, varied in character from pronouncedly columnar to wholly nuclear, depend-

ing on the pouring temperature. Pouring from 1,695 to 1,675 deg. C. caused the columnar zone, which started very near the surface, to stretch almost into the centre of the bar (Fig. 7(*a*)). If pouring was done from 1,675 to 1,650 deg. C., the columnar zone was smaller, whereas the zone of equiaxial crystals in the centre of the bar was larger. Between 1,650 and 1,625 deg. C. the columnar crystals were still shorter, the equiaxial zone expanding outwards, and in the centre the equiaxial crystals became so small that they gave the impression of virtually a nuclear structure (Fig. 7(*b*)). At lower pouring temperatures, crystals as main component, was represented by contraction curves with low rate of contraction in the beginning of interval III (Figs. 7(*a*) and 6(*b*)). The mixture of columnar and equiaxial crystals of varying size that occurred when pouring between 1,650 and 1,575 deg. C. corresponded to the standard curve (Figs. 7(*b*), (*c*) and 6(*a*)), whereas the lowest pouring temperatures, 1,575 to 1,565 deg C., yielded a nuclear pattern and a curve with high rate of contraction in interval II, which diminished continuously in interval III (Figs. 7(*d*) and 6(*c*)).

All specimens in Fig. 7 (*a*) to (*d*) derived from test-bars in which contraction was prevented by the

FIG. 6.—*Characteristic time/contraction curves.* (*a*) *standard composition* (*s.c.*), *pouring temperature* (*p.t.*) 1,600 *deg. C.* (*standard curve*), *excess temperature* (*e.f.*) 85 *deg. C.*; (*b*) *s.c., p.t.* 1,695 *deg. C., e.t.* 170 *deg. C.*; (*c*) *s.c., p.t.*, 1,565 *deg. C., e.t.* 50 *deg. C.*; (*c*) *s.c., p.t.* 1,565 *deg. C., e.t.* 85 *deg. C.*; (*e*) 0.41 *per cent. C., p.t.* 1,575 *deg. C., e.t.* 85 *deg. C.*; (*f*) 0.12 *per cent. Mn or* 0.070 *per cent. P. or S, p.t.* 1,600 *deg. C., e.t.* 85 *deg. C. The curve* (*a*) *shows also the initial "expansion." The crosses in the same curve indicate the times at which the spring load has been removed in a series of tests. The arrow in* (*c*) *shows the situation of the break between intervals II and III.*



1,625 to 1,575 deg. C., the equiaxial crystals were successively replaced by nuclear, while at the same time the columnar crystals became shorter (Fig. 7(*c*)). At the lowest pouring temperatures employed, 1,575 to 1,565 deg. C., the structure was wholly nuclear (Fig. 7(*d*)).

It is of interest to compare the pouring temperatures corresponding to different freezing structures with the pouring temperatures described in the preceding section referable to different types of contraction curves. It was found that pouring from 1,695 to 1,650 deg. C., which yielded a pronounced dendritic structure with unidirectional columnar resistance spring during a sufficient time for the solidification to be definitely completed throughout the bar. The times or the spring deformations were, however, not identical in all experiments so that only the shape of the tears, and not their size, could be compared. The cracks were typical hot-tears—that is to say, they had uneven surfaces, a more or less discontinuous course and followed the primary grain boundaries or possibly passed between the branches of the dendritic crystals. On bars which had been pulled entirely apart, the fracture is seen to be brittle. The tears follow the primary structure too, inasmuch as in a columnar

Metallurgical Aspects of Hot-tearing

structure they were straight and coherent (Fig. 7(*a*)), whereas in a structure with larger proportion of equiaxial crystals they were less coherent (Fig. 7(*d*)).

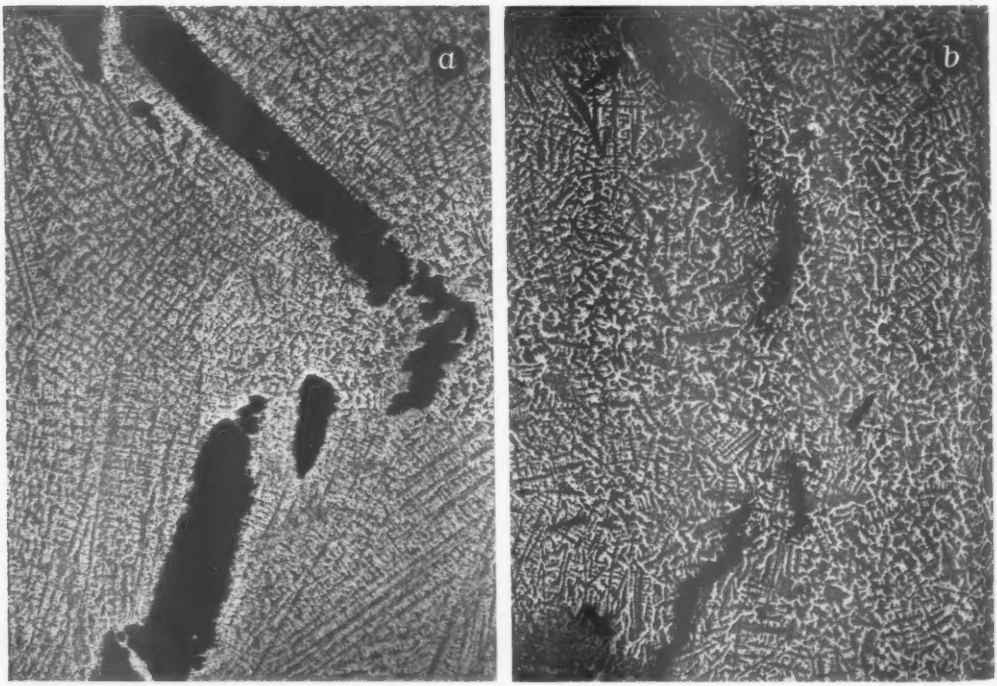
It is manifest that in the columnar zone, when existent, the tears are very readily opened in the longitudinal direction of the dendrites (Fig. 7(*a*)). In specimens poured at lower temperatures the tears appeared both as cracks in the columnar zone running to the surface, and possibly a little inside it, and as smaller, separate cracks in the inner crystal zone (Fig. 7(*b*)). In the event of sufficiently far-reaching expansion these inner tears might be combined into one. The occurence of a number of non-coherent tears was especially marked in specimens with nuclear structure (Fig. 7(*d*)).

A series of pouring experiments in which the load from the resistance spring was removed 0, 22, 28, 34, 40, and 60 seconds after the start of pouring was made with test-bars type A, standard composition and 1,600 deg. C. pouring temperature. The positions of these times in relation to the contraction curves have been marked with crosses in Fig. 6(*a*). The time 0 implies that the bar was left to contract freely. The tear region in the various cases is illustrated in Fig. 7(*c*) (40 sec.).

The free contraction does not give rise to open tears. On the upper side of the specimen, however, was a segregation line running to the surface, which meant that a tear had arisen there at some stage of the solidification. Subsequently, this tear had manifestly been filled in with enriched melt from internal portions, which consequently must have been liquid at the time when the tear had occurred. All the other specimens had open cracks, broader and running deeper the longer they were loaded. In the 22- to 40-sec. specimens, moreover, they grew in number, while in the 60-sec. specimen corresponding to the time when contraction approached zero they combined into a single crack. The existence of open cracks in the 22-sec. specimen showed that the change in slope of the contraction curves, occurring after about 26 seconds, did not imply incipient tearing.

The solidification in the tear region in the case of test-bars containing 0.24 per cent. C. was completed about 26 seconds after the start of pouring. The very last stage of solidification did not show up on the cooling curves, but the true solidification time was presumed to be rather longer. Specimens were obtained from which the spring load was removed after 0, 22, and 28 seconds. They resulted from a similar experimental series on steel containing 0.03 per cent. C. As at 0.24 per cent. C.

FIG. 7 (*a*) *and* (*b*).—*Appearance of tears and structures in test-bars with standard composition poured from* (*a*) 1,695 *deg. C. and* (*b*) 1,650 *deg. C.* (*Stead's etchant: magnification* ×4).



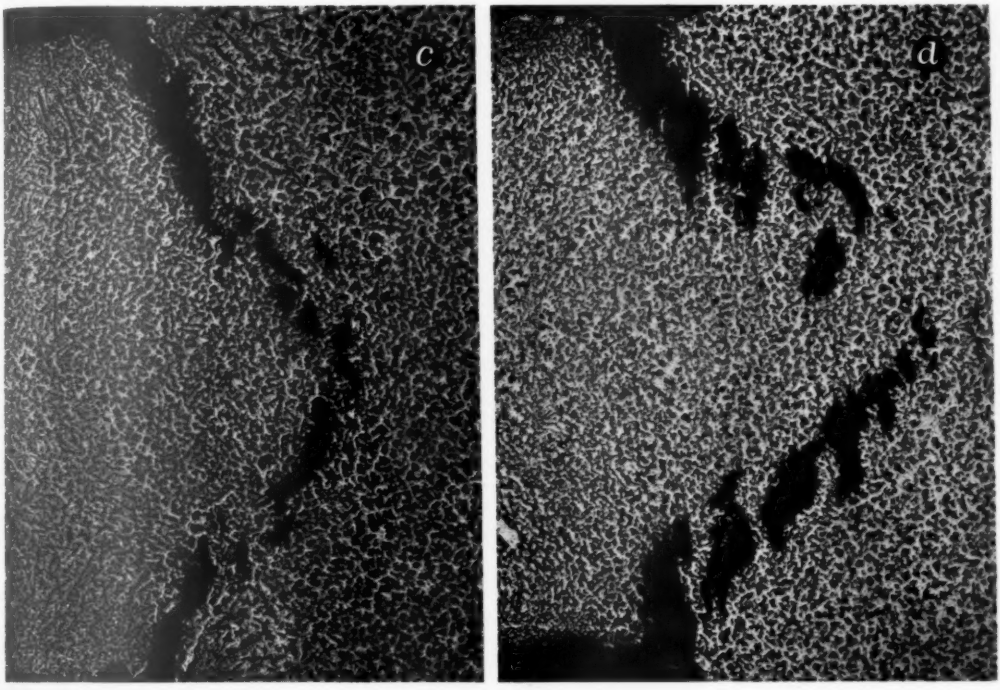


FIG. 7 (*c*) *and* (*d*).—*Tears and structures in similar test-bars, poured from* (*c*) 1,600 *deg. C. and* (*d*) 1,565 *deg. C.* (*Stead's etchant: magnification* × 4.)

filled but not open tears occurred in the freely-contracting specimen. The cracks evidently did not proceed to the surface, which might have occurred, however, outside the section. For the tears to reach the surface in another section, they must have formed inside the surface. In the remaining specimens there were open tears, but to a very much lesser extent than in corresponding specimens containing 0.24 per cent. C. After 22 sec. loading the tears did not proceed to the surface, which they did do after 28 secs. The circumstances were similar in specimens of more dendritic structure after 22 sec., whereas after 75 secs. the size of tear was greater than in the nuclear structure but smaller than in comparably loaded specimens with the higher carbon content.

From experiments with 0.03 per cent. C. and elevated phosphorus content, 0.075 per cent. are illustrated in Fig. 8, two specimens with nuclear structure from which the load was removed after 22 and 36 sec., and two with dendritic structure unloaded after 10 and 60 seconds. In all specimens the tears were negligibly larger than in corresponding specimens with normal phosphorus content. Especially in the dendritic structure, on the other hand, the internal tears were larger and were distributed over a greater number of adjacent streaks between the dendrites. There was also an abundance of filled tears. Experiments with higher sulphur content, 0.135 per cent. yielded somewhat greater tearing than with 0.075 per cent. phosphorus, and again the tears appeared to have been initiated at a greater number of points than was the case with normal sulphur content.

Examination of the tears from the 0.03 per cent. C. experiments, which were interrupted before the slope changed between intervals II and III on the contraction curves, showed that only in exceptional cases had they reached the surface and in no case had they opened to any appreciable extent there. In corresponding tests with 0.24 per cent. C. the tears reached the surface but especially on the upper side of the tear region they were still equal in width, or even wider, further in, which meant that they had arisen and started to expand inside the casting. In tests interrupted in interval III, on the other hand, the tears always reached the surface and were generally wider at the surface than nearer the centre (see Fig. 7(*c*) and (*d*). The latter phenomenon was the more accentuated the later the load was removed. Even in specimens which had passed one or more changes of slope within interval III, however, it was often noticeable that the width of outward-running tears was smaller out on the surface than in the portion immediately below (Figs. 7(*a*), (*b*)).

Metallurgical Aspects of Hot-tearing

These various observations suggested that the lowered rate of contraction that always occurred after 22 to 32 sec. was due to the fact that, by that time, the tears had reached the surface of the bar over the larger part of its periphery and that they subsequently expanded from the periphery inwards.

Measurements of the temperature in different parts of the bar showed that at the time in question the thinner section of the bar has solidified, whereas in the central portions of the tear region the solidification was in its final stage. This might suggest that a connection existed between the tear formation during the final solidification and the changed rate of contraction. Casting experiments with different springs, however, showed that the contraction curves were of similar shape in all cases, but that the breaks in the curves came later in the case of the weaker springs. Thus with a 3.0 mm.-thick spring the change of slope occurred after about 50 sec., when the entire bar had certainly solidified. The reduced rate of contraction therefore could be related to tearing caused by solidification conditions.

Marked segregation lines, indicating tears filled with enriched melt, were observed to a greater or lesser extent in all tests where the tear had not proceeded very far. The fact that they were more difficult to find in specimens with serious tears must have been because cracks formed inside the once filled portions had torn these up in the course of their expansion. It was clear, however, that the filling of formed tears was a universal feature in the tearing process. To facilitate their identification in the structure photographs, the position of certain filled tears has been marked with arrows in Fig. 7(*b*).

The occurrence of filled tears in freely-contracting test-bars was always limited to the outer portions of the tear region. The filled tear channels were practically equal in width both in freely-contracting and in spring-loaded specimens.

If small open tears were studied in detail, they were seen to consist of alternate narrow and wide portions as shown by the ringed-in tears in Fig. 8(*b*).

On some occasions, despite normal silicon content in the steel, blow-holes occurred in the test-bars and even in the tear region. They may be assumed to have derived from hydrogen entering the melt from moist scrap or the like. On those occasions casting was done at carbon contents which in other experiments produced very little hot-tearing. This was the case, too, in the specimens containing blow-holes, both when the latter were in the centre of the tear region and when they were immediately below the surface at the base of the tear cone. No change in the character or extent of the tears was noticeable even when the blow-holes were on the normal path of the tears.

Appearance of Slag Inclusions

The appearance of the slag inclusions was studied on unetched and etched surfaces from experiments in which the steel had been deoxidized with silicon and manganese and two different aluminium contents. In specimens killed with silicon and manganese alone, sulphide inclusions (grey, opaque) and silicate inclusions (vitreous) occurred. They were comparatively few at normal sulphur contents. The inclusions were mainly concentrated at the primary grain boundaries. At high sulphur content the quantity of sulphides was very large. They were concentrated in long chains in the primary grain boundary. An accumulation of sulphide inclusions occurred both at low and high sulphur contents in segregations which constituted filled tears.

In the presence of aluminium in contents of 0.04 to 0.05 per cent. and normal sulphur content, the sulphide inclusions had roughly the same character as in the sulphur-rich specimens without aluminium. In addition, darker-rounded inclusions occurred, which usually surrounded a smaller sulphide inclusion. If the aluminium content was increased to 0.10 per cent., the latter form of inclusions predominated and free sulphides were rare.

Results of Casting Experiments

The study of the growth, size and location of the hot-tears, and of the solidification structure in test-bars from experiments with varying composition of steel and varying pouring temperature, led to the following interpretation of the implications of the time-deformation curves from the point of view of tear-susceptibility. (1.) Curves of the types shown in Fig. 6 (*c*), (*d*), and (*e*) are characteristic of test-bars in which there is little tear formation. The size of the tear increases in the order (*d*), (*e*), (*c*), but the differences between them are small. (2.) Curves of the types shown in Fig. 6 (*a*), (*b*), and (*f*), are characteristic of test-bars with serious tear formation, the size increasing in the order (*a*), (*b*), and (*f*). The differences are more marked than within the first group.

It may be said in general that the more the curve of restrained contraction deviates from the rectilinear contraction in interval II, the greater is the tear formation in the bar. In comparing the tear-susceptibility of different alloys, attention was also paid to the size and number of tears in the experimental series described. It was observed that alloys which yielded few and small tears in early unloaded specimens yielded comparatively small tears also in later unloaded specimens. The influence of the varied factors on the hot-tear susceptibility may then be classified as follows.

Pouring temperature.—If pouring be done from a temperature so high that a pronounced columnar zone arises, greater hot-tearing will occur than if a pouring temperature is used such that the structure will mostly consist of equiaxial crystals of varying size. The smallest tear formation occurs if the pouring temperature is so low that the structure is predominantly nuclear.

Carbon.—0.02 to 0.15 per cent. C. causes the lowest tearing, and 0.19 to 0.32 per cent. C. the largest. Carbon contents between 0.36 per cent and 0.66 per cent. cause somewhat larger tears than the

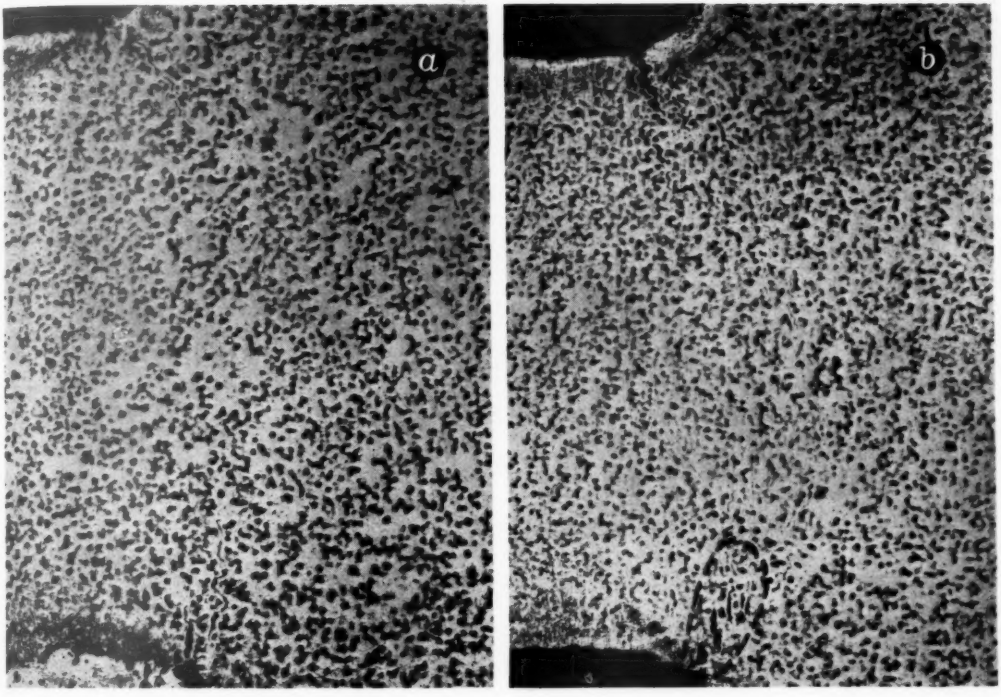


FIG. 8.—*Tear region in test-bars with* 0.03 *per cent. C. and* 0.075 *per cent. P. E.t.* 85 *deg. C.; globular structure; spring load removed after* (*a*) 22 *sec.* (*b*) 34 *sec. Oberhoffer's etchant; magnification* ×4.

lowest carbon contents.

This difference between hot-tear susceptibility at different carbon contents persists irrespective of the nature of the solidification structure. At high pouring temperatures, however, causing a wider columnar zone, the differences are smaller. This indicates that the influence of the crystal structure, and hence of the pouring temperature, is a more important factor than the carbon content. In order to utilize fully the advantage provided by a change in the carbon content, pouring should be done at a temperature so low as to avoid a pronounced columnar zone.

Silicon: 0.14 to 1.08 per cent. Si does not affect the size of tear in specimens of standard composition.

Manganese: 0.12 to 0.36 per cent. Mn causes heavier tears than 0.42 to 1.17 per cent. Mn. Variations within the latter range do not cause divergencies from the tear encountered in the standard composition (0.80 per cent. Mn).

Phosphorus: 0.008 to 0.060 per cent. P does not appreciably affect tearing in specimens containing either 0.24 per cent. C. or 0.03 per cent. C., whereas 0.070 to 0.130 per cent. P increases the tear formation at both carbon contents.

Sulphur: 0.017 to 0.053 per cent. S does not appreciably affect tearing in specimens containing 0.24 per cent. C. or 0.03 per cent. C., whereas 0.067 to 0.150 per cent. S increases the tear formation at both carbon contents.

Aluminium: Compared with 0 to 0.023 per cent. Al., 0.043 to 0.048 per cent. Al. causes greater tear formation in specimens containing 0.017 to 0.053 per cent. S and otherwise standard composition whereas 0.098 to 0.099 per cent. causes less tearing.

(*To be continued*)

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[1] W. S. Pellin : *Foundry*, **80** (1952): 11, 124-133, 192, 194, 196, 199.
[2] E. A. Lange and R. W. Heine, *Trans.* Am. Foundrymen's Soc. **60** (1952), 182-196.
[3] E. Magnusson: *Jernkont. Ann.*, **131** (1947), 212-224.

UNITED STEEL COMPANIES, LIMITED, Sheffield, recently held a "Staff Only" party at their offices in Westbourne Road, Sheffield, when there were more than 250 present. Prizes were distributed by Mrs. R. Peddle, wife of the secretary of the firm, Mr. Ronald Peddle.

THE Butterley Company, Limited, Ripley (Derbyshire), which recently sold its prizewinning herd of Red Poll cattle following a Ministry of Power decision to take over the herd's 300 acres of grazing land for open-cast operations, has now decided to break up its 550-strong herd of pedigree Large White pigs.

Equipment & Supplies

Heat-treatment Furnace for Light-alloy Castings

Royce Electric Furnaces, Limited, of Walton-on-Thames, Surrey, have recently installed a new, forced-air circulation furnace for annealing, solution heat-treatment and ageing of aluminium-alloy castings at the works of Cambrian Castings, Limited, of Hirwaun, Aberdare.

For the high-grade light-alloy castings produced by Cambrian Castings, a furnace having an extremely close degree of temperature control and uniformity was required. The furnace installed (Fig. 1) enables the firm to meet the AID test for light-alloy specification over long cycle periods.

It is one of the standard range of VFC type furnaces produced by the manufacturing company, ranging in sizes from 10-in. dia. by 10-in. deep to 36-in. dia. by 60-in. deep; it may be used for tempering, preheating or similar heat-treatment at temperatures up to 750 deg. C. To achieve the close control and uniformity, high-velocity air circulation is passed over the heating elements housed in a baffled annulus surrounding the work chamber, the heated air passing through the charge on return. Heat is, therefore, transferred to the charge by forced convection, giving a uniform and rapid-heating cycle.

Heating elements are of 80/20-nickel/chromium, suspended directly in the air stream and shielded from the work chamber to eliminate direct radiation. Air circulation is produced by a heat-resisting steel unit, a high-velocity centrifugal fan being mounted in the base of the furnace. The air impellor is designed to displace under all temperature conditions, the maximum volume of air with widely varying conditions of pressure which may be imposed by different types of charge and density of loading. An air-cooled motor with a heat-resisting steel extended spindle gives a good performance for the combined duty of high speed and elevated temperature.

FIG. 1.—*New furnace for light-alloy castings installed for Cambrian Castings, Limited, by Royce Electric Furnaces, Limited, of Walton-on-Thames.*

Charge baskets are provided and heat-resisting castings are fitted in the base of the furnace chamber to support heavy loads. The lid is operated by hand by a lever-linking mechanism which locks it in the raised position for moving to one side. A back-post pivot fitted with ball-race bearings makes this a simple operation and therefore suitable for solution heat-treatment. To meet AID requirements, the control gear includes an Electroflo automatic indicating controller and three-point recording instrument. A delta-star switch is included to reduce the rating to one third for operation in the lower-temperature range. An additional instrument is provided as an over-riding excess-temperature cut-out.

Stock-controlling Device

A method of checking on stocks of items which are constantly drawn upon is provided by the Stoktrol. Manufactured by K. Bisset & Company, Limited, 145, Grand Buildings, Trafalgar Square, London, W.C.2.

The standard machine has three large dials in appearance not unlike those on a telephone. The stock in hand is shown on three oval "windows" at the top of the machine. As stock is issued, the quantity is "dialled" by a stylus on the three dials (for hundreds, tens and units, respectively). Remaining stock is shown in the windows. Apart from stock control, the machine has other uses. It can be used for batch counting, for example. As items pass along the production line, a figure can be dialled, and the result will show how many more items would be needed to make up a particular batch. Similarly, in production control, the target figure can be shown. As production proceeds, the numbers would be dialled, thus showing the balance required at any particular time. Capacity of the Stoktrol is 1,000 but models can be produced to deal with higher figures. The machine can also be supplied to add instead of subtract.

Hosepipe Assembly Vice

To speed fitting and renewal of connections to hosepipes, the Consolidated Pneumatic Tool Company, Limited, of 232, Dawes Road, London, S.W.6, have introduced a new piece of equipment. The apparatus consists of a 2½ in.-diameter single-acting spring-return cylinder with a 3-in. stroke piston, the cylinder being mounted on a baseplate with a hose-clamping vice facing the cylinder and piston and mounted on the same baseplate. The two jaws of the vice are fitted with removable inserts to accommodate different diameters of hosepipe. Operation of the unit consists of gripping the hosepipe in the vice, fitting a hose connection to the piston rod and operating the air valve.

BROOK MOTORS, LIMITED, have announced a new type "C" drip-proof electric motor in which modern insulation techniques, wire coverings and production methods are used to obtain the same output from a smaller frame size. The motor incorporates a modified ventilation system which avoids hot spots and gives equal cooling to all active parts. The air stream is drawn into the ends of the motor, guided by air deflectors, which also serve as additional protection for the end-windings and after passing over the windings, is expelled through openings in the yoke castings. The new specification permits a temperature rise of 65 deg. C. with an ambient temperature of 40 deg. C.

*Craft Apprentices' Corner**

Open-sand Moulding . . . .

. . . . with "Tubal Cain" on the Job!

Y'know fellers, this foundrywork ain't no picnic; there's an awful lot of things to be learned and remembered; an awful lot o' things to watch out for; an awful lot o' things to go wrong just when you don't expect 'em. I remember one time when I had Enoch make me some open-sand floor-plates, four foot by two foot I told him, seven-eighths thick, a dozen of 'em I wanted. "Get 'em made sometime this week," I says, "We'll lay 'em in the top gangway on Saturday morning."

So he did, three or four one day, two or three another day, come Saturday morning the twelve of 'em were in the fettling shop, brushed off and ready for laying. But somehow they didn't look right there didn't seem to be anything *really* wrong, they just didn't *look* right for the job. Well, the fellers levelled off the gangway, scattered some loose sand over, laid the first plate bedded it down solid. "Ain't any too wide, is it?" says Sam, kind of pointed like. "Should be," I says, thoughtful like, "a four-foot gangway's wide enough to take a wheelbarrow, comfortable, but this 'un's a bit tight." So I dropped the old two-foot rule across the plate and I knew what was wrong, 3-ft. by 18-in., they were.

Well o' course, I sent for Enoch as soon as he turned up Monday morning. "Nice job you made o' them plates, Enoch," I says, "four foot by two foot I told you. Just use your two-foot rule," I said, "twice for the long side, once for the short 'un. Did you do that?" "I did Gaffer," says Enoch, "Y'know I allus does as y'tells me." "I ain't exactly disbelieving y'Enoch, but how comes them plates are three foot by eighteen inches?" "Don't know 'bout that" says Enoch, "never was much of a scholard meself. But I *do* know I give 'em two for the long side and one for the short 'un. Mind you," he says—coming all over knowledgeable like —"there's six inches broke off the end o' me rule, its bin like that fer ages!"

Well, what can you *do*?

All-important Bed

Talking of open-sand plates, I reckon y'know what's wanted in that line? It's your bed, fellers. —Take a look at the sketches on the next page. Must be dead level, and soft, and vented well. Lay your first levelling strip down and set it with the spirit level. Ram it firmly in so it won't shift after you've set it. Lay your second levelling strip and set it the same way, not only level along the strip, but also across the width of the bed. You'll do this best by spanning the two levelling strips with a third straight-edge, and the best and safest check is diagonally from corner to corner. Right, now loosen up the floor sand between the strips and fill-in with some nice backing sand, well mixed, no lumps, rather dry-ish (pass it through a ½-in. riddle if you wish). Fill up to about 2 in. above the level of the strips and pat it lightly and evenly all over with the blade of your shovel, only just enough to compress the top surface. Now strike off the surplus sand with your straight-edge. You then have your bed, but it's rough. Pass some floor sand through a ¼-in. sieve over the whole surface of the bed *evenly* to about ¼ in. above the strips. Remove this surplus by "sawing" across and along the strips, but all the time keep the straight-edge firmly on the strips with a little downward pressure. Repeat the "sawing" with a very thin even layer, and your bed is ready for working on.

If it's plates you're making, a flat frame pattern is the best thing to use; rest this on the bed and pack riddled floor sand against the outside, striking off the surplus sand level with the top of the frame. If you haven't got a pattern of the right size then you must use your straight-edge. Make up the one side first, longer than the required length of the plate. Remove the straight-edge and re-position it to form one adjacent side. Check the angle with a tri-square. Make up this side and remove the straight-edge. Measure off the required distance along this side and position the straight-edge to form the third side; don't forget to check the angle. Make up this third side and remove the straight-edge. Set the straight-edge for the remaining side by measuring off the required distance (from the second side) along the first *and* third sides. Make up the fourth side as before. The thickness of the plate is determined by cutting a flow-off at the end or side of the mould. Make up a wide-mouthed pouring basin, pass a long vent-wire under the bed and your job is ready for pouring. *N.B.*, don't forget contraction allowances in working out your sizes—normally $\frac{1}{10}$ in. per ft., but in cases of high-strength irons as much as $\frac{1}{8}$ in. per ft.

Equipment? Well, for the levelling strips, wood is satisfactory but metal is better; channel iron, steel rail, a moulding-box frame, almost anything can be utilized, providing it is smooth and straight along one edge. For striking-off, a wooden straight-edge is best (say, 3-in. by 2-in. section) because it is light, easily handled and rigid in use, but constant rubbing against the levelling strips will cause local wear and, hence, inaccuracy.

* Written somewhat in the vernacular and chatty style common to the foundry floor, it is the intention to publish a series of articles for the practical guidance of the younger entrants to the industry. Apologies are made in advance to those who would seek to translate these articles into foreign languages.—EDITOR.

Open-sand Moulding

For core-grids without prodders, a bed prepared as outlined earlier will be quite satisfactory, but it is *not* suitable for grids which need to have prodders pushed down into the bed. These deep prodders will exert pressure against the sand, and unless the bed is reasonably sound the prodders will be rough and irregular and may even run into each other. This can easily be overcome when initially preparing the bed, and it is wise in such cases to tread the sand in between the levelling strips so as to consolidate it without making it hard. However, I shall have more to say on the subject of core-grids at a later date, but it is well to remember the difference in the preparation of the bed.

Well now, young fellers, if you ain't never tried your hand at open-sand work this'll make a nice little exercise for you. Just do like it says and you'll be alright. But watch that sand so it ain't too moist, and don't make that bed hard or you're simply *asking* it to scab, and use that vent-wire too! You notice I don't say anything about sleeking the bed with your trowel; well, I ain't saying it can't be done if it's done only very lightly and evenly, but if you put any pressure on that trowel it's likely as not your plate will scab to blazes.

Oh, and by the way, I'm betting there ain't one in four of you got a two-foot rule in his toolbox. Am I right? I thought so! Get one son, and get into the habit o' carrying it and using it. An all-steel, two-foot, two-fold rule is a very useful tool, son, a very useful tool!

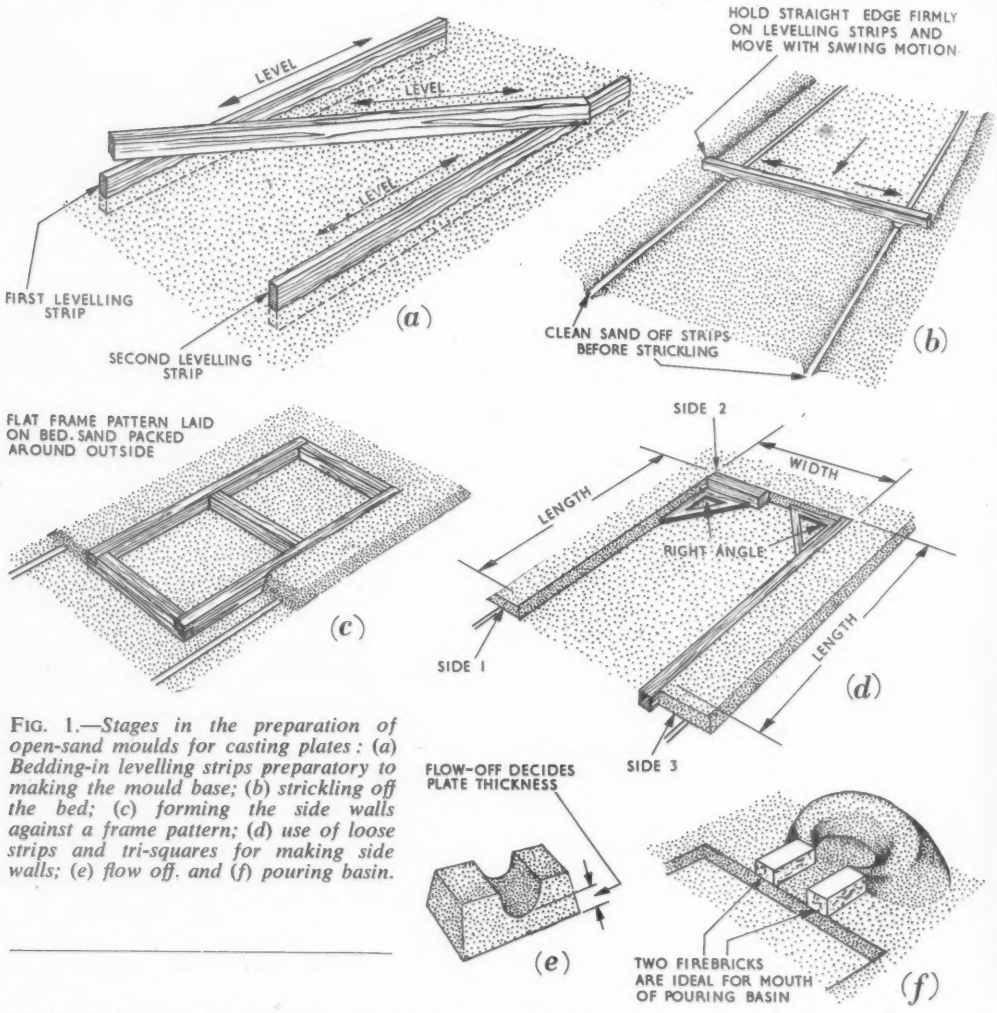

FIG. 1.—*Stages in the preparation of open-sand moulds for casting plates: (a) Bedding-in levelling strips preparatory to making the mould base; (b) strickling off the bed; (c) forming the side walls against a frame pattern; (d) use of loose strips and tri-squares for making side walls; (e) flow off, and (f) pouring basin.*

Not Much Out of the Ordinary!

"Not much out of the ordinary" was the gem of typical British understatement applied by Davy & United Engineering Company, Limited, Sheffield, when this JOURNAL requested details of the despatch by rail of a very heavy steel casting from their works. The job in question—the main "C" frame weighing over 140 tons, for a 1,350-ton hydraulic hot slab-shear which Davy & United are building for John Summers & Sons, Limited—was destined for the Hawarden Bridge steelworks at Shotton. For the transport of this huge component by rail from Sheffield to the Hawarden Bridge works in Cheshire, British railways provided special low wagons of cantilever construction, and transit over a week-end necessitated a special working schedule over the route, accompanied in some instances by temporary slewing of the rail-lines below the apex of bridges, so as to give sufficient height to permit the "C" frame to pass. When a similar casting (Fig. 1) was sent to Dorman Long's, Middlesbrough works a short time ago, it was then described as the largest casting ever to leave Sheffield by rail (though not, of course, the heaviest to leave by road!).

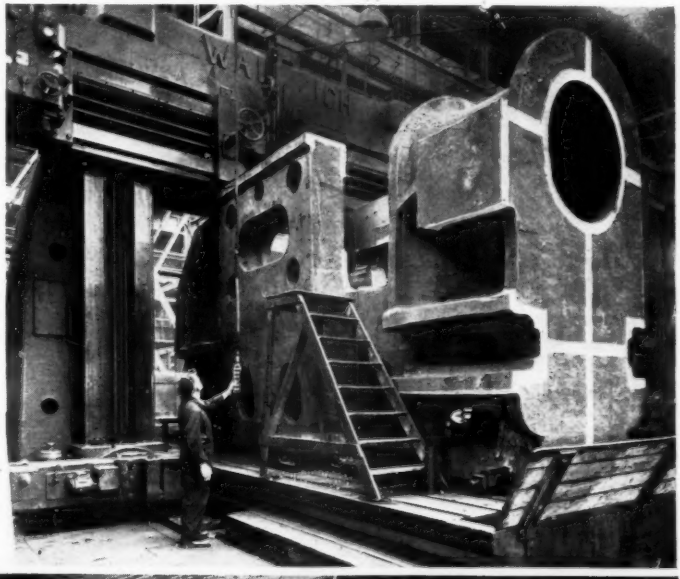

FIG. 1.—*Machining on a large planer at the Darnall Works of Davy and United of the "C" frame for a hot slab-shear of the type being built by the firm for John Summers & Sons, Limited.*

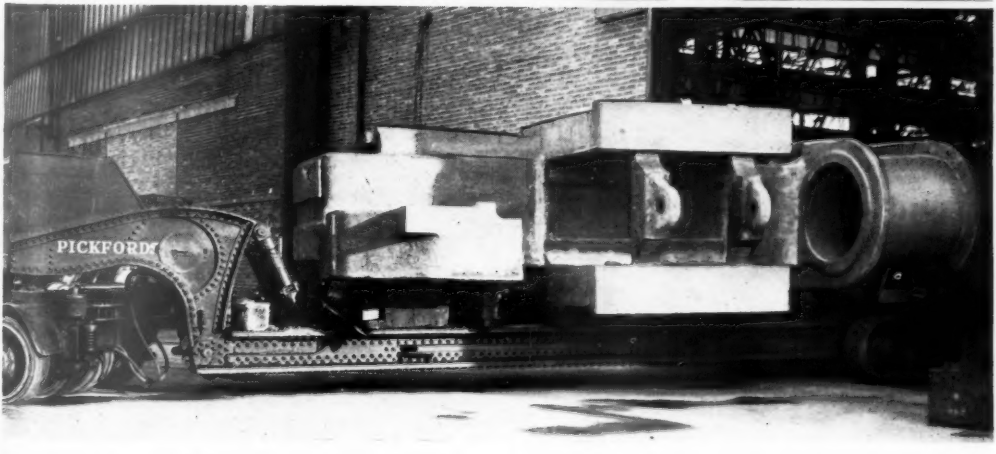

FIG. 2.—*"C" frame casting arriving by road at Darnall Works from the Grimesthorpe foundry of English Steel Castings Corporation, where it was cast; it weighs over* 140 *tons.*

BRITISH ROAD SERVICES are to undertake a large-scale programme of development, at a cost of over £100,000, at their general haulage depot at Bromford, Birmingham.

AS FROM JANUARY 20 the Nottingham area sales office of Lancashire Dynamo Group Sales, Limited, will be at 2, St. James's Terrace, Standard Hill, Nottingham (Telephone:—Nottingham 43025/6).

F

Notes from the Branches

Wales and Monmouth

On a Saturday in November, a party of 60 members of the Wales & Monmouth branch of the Institute of British Foundrymen visited the Tredomen Works of the National Coal Board at Ystrad Mynach (which incorporates one of the Board's foundries). Arriving at 11 a.m., they were met by Mr. K. P. James, works manager, and various members of his staff who acted as guides, each taking charge of ten visitors.

Interest naturally centred upon the foundry which produces steel, iron and non-ferrous castings, chiefly for the mining and closely associated industries. As an example, the production of colliery tram wheels is in the region of three or four thousand per week. Three moulding machines are employed, two making bottom-half, and one, automatically operated, making top-half of moulds. Members followed each operation down to the knock-out station—here a dust-extraction plant has been installed and the absence of dust and fumes was particularly noted.

Melting plant at Tredomen includes two cupolas of 8 tons per hour capacity and three Tropenas converters of 3 tons, 2 tons and 30 cwt. capacity; fumes from the converters are extracted by a fan capable of 48,000 cub. ft. per min. The sand plant installed includes two hoppers of 150-tons capacity and two of 40 tons, a sand mill and a Speedmuller. The whole operation from delivery of the sand to the mill, mixing, delivery to machines, knock-out, separating and cleaning of returned sand is controlled from a central panel. Castings pass through a Wheelabrator cleaning plant and through normal fettling operations to the final process of heat-treatment. The considerable variety of castings produced range in weight from a few pounds to 7 tons. In spite of all the activities in the foundry, the atmosphere was remarkably clean, due to the efficiency of the air-conditioning equipment; there is also an excellent ablutions department which enables operators to be as clean, when they leave work as when they arrive.

Before the members departed, Mr. Gaze, branch president, thanked Mr. James on behalf of those present for a most interesting morning, saying that the courtesy and assistance of the guides was greatly appreciated. Mr. James briefly replied that it had been a pleasure for him and his colleagues to entertain the visitors, and he looked forward to visits by branch members in the future when they hoped to have made further improvements in the foundry.

Lancashire

At the December meeting of the Lancashire branch held on a Saturday afternoon in the Midland Hotel, Manchester, a paper entitled "Mechanical Aids to Shell Moulding" was read by Mr. D. H. Scott, of E. Green & Son, Limited, Wakefield, and illustrated by a colour ciné film and slides.

First, the branch president, Mr. E. H. Beech, extended a welcome to new members present and especially welcomed Mr. Allenbach who was there on a visit from Sweden. Introducing Mr. Scott, he remarked that he was controlling a foundry producing 300 tons of castings per week of which 40 tons were shell-moulded. Mr. Scott then described his film and slides during their projection and gave details of the methods he used in shell moulding, including an account of the automatic production of shell cores.

Opening the discussion, Mr. A. Kirkham proposed a vote of thanks to Mr. Scott and said, jocularly, that the lecturer had convinced him that they could make moulds, in addition to playing cricket, in Yorkshire! Mr. Willis seconded the proposition, saying that such an excellent film should go a long way to encourage others engaged in shell moulding to persevere with their efforts to place it on a really high production basis. During the discussion, several members asked about comparative costs of shell and green-sand methods of mould making. The lecturer, replying, contended that any extra cost in shell moulding could be saved in the machine shop if jobs were properly selected, and ably answered many other questions on techniques used by him to produce both shell moulds and cores. The chairman, summing up the discussion, said that Mr. Scott had established the fact that there was plenty of scope in the foundry industry for shell moulding, and he hoped that, in the not-too-distant future, Mr. Scott would return to Manchester and report much further progress.

Slough

At their January meeting, the Slough section were privileged to hear a paper entitled "Pressure-die-casting," given by Mr. H. J. Sharpe, of Hoover, Limited.

Mr. Sharpe commenced his lecture with a short outline of the process, this being for the benefit of the foundrymen who were not familiar with die-casting. He described the various types of machines used, the methods of injecting the metal, applying pressure, etc. This was followed by a general review of the advantages and disadvantages of the process, comparing it with other casting methods, *i.e.* sand- and gravity-die-casting. He then dealt at some length with the various factors which are essentials for good commercial castings, such as surface finish, dimensional accuracy, production rate, and costs. He stated that when large numbers of a particular casting are required, pressure-die-casting is undoubtedly the cheapest method of producing a component with a good surface finish, reasonable mechanical properties, high standard of accuracy and consistency, with a high rate of production in the minimum of floor space.

Designing for the Process

Mr. Sharpe went on to say that the process is largely limited to zinc- aluminium- and magnesium-base alloys, and pointed out that a high capital investment was required and of course a high overhead. He emphasized that if the best results were to be obtained from the process it was essential that the casting should be designed as a pressure-die-casting. Following up this general review, Mr. Sharpe gave members a detailed description of a number of recent developments of the process, which included vacuum die-casting, magnesium casting methods, investigational techniques and the latest developments in steels used for making dies. The lecture was illustrated by an excellent series of slides and Mr. Sharpe must be congratulated on the effort he undoubtedly put into the preparation of these.

An interesting discussion followed, Mr. Sharpe answering very ably the many questions put to him by members, and the meeting concluded with a vote of thanks to Mr. Sharpe, proposed by Mr. J. P. P. Jones, and seconded by Mr. Hoesli.

GAS PURIFICATION & CHEMICAL COMPANY, LIMITED—Mr. D. D. Mathieson has been appointed chairman in succession to Mr. J. R. Sorsbie, who has resigned from the board owing to ill-health. Mr. L. L. Rossiter continues as deputy chairman.

Cupola with Continuous-slit Tuyeres

By A. A. Anan'in and B. P. Chernobrovkin

The intensity of combustion occurring in a cupola is governed by the amount and quality of the fuel, and on the quantity, temperature and composition of the blast. The present method of applying blast is thought, by the Authors, to prevent the maximum effect from being obtained. This has resulted in their developing a new tuyere system in which the blast is introduced through peripheral slits; the following short article contains brief details of the construction employed and the results obtained from this method.

The Liteishik foundry at Sverdlovsk, Russia, is equipped with one cupola without a forehearth; its output is in the order of 15 cwt. per hour, being tapped every seven to nine minutes. The tapping is followed by hand pouring from 44-lb. capacity ladles. The metal charge consists of 2 cwt., whilst the operational coke charge is 35-lb.

Prior to reconstruction, the 23-in. dia. cupola was fitted with one row of separate tuyeres, which produced the following operational characteristics: Length of run—two to three hours; output—15 cwt.; tapping temperature—1,270 to 1,290 deg. C., and a melting coke charge of 16 per cent.

A continuous-slit tuyere of simple design was used to obtain uniform air blast. Rings, or tuyere plates, were cut from steel plate, 0.3 to 0.4-in. thick, with an outside diameter equal to the diameter of the cupola casing, and an inside diameter equal to the inner diameter of the lining, and therefore equivalent to the thickness of the lining. Supports were welded to one side of the plate, spaced at between four and six inches; these supports maintain the width of the tuyere slit at the required measure, and form a rigid support for the structure. To facilitate assembly, these rings were constructed in four segments. The ring was placed on a row of firebricks at the level of the first row of tuyere openings in the cupola casing, forming a continuous-slit tuyere and also the support for the next layer of refractory; the plates of the second and third rows were mounted in a similar manner.

Variations Recorded

A system of separate tuyeres and a continuous-slit type differ in that the individual tuyeres of the former had different blast pressures, whilst the latter type equalizes the pressure (the blast being fed into the system by a wind belt, extending over the whole circumference of the cupola).

The steepest rise of temperature and the highest mean temperature were recorded when 60-80 per cent. of air was supplied through the bottom tuyere. As in the operation of one continuous tuyere, no solidification of metal in the tuyeres was observed and the erosion of the lining was uniform. It was, however, observed that the increased blast, through the top tuyere, intensifies the lining erosion in the melting zone.

Experiments were made using either one, two or three tuyere-slits, the pressure and volume of plant to each of these slits being independently controllable. Experimental runs with a two-slit tuyere system show that the best results are obtained if 60 per cent. of the total blast is blown through the bottom slit. This ratio was adopted as a base in the investigation of the influence of various ways of dividing the air supply to individual tuyeres in a three-row cupola system. In this type of cupola, the tap-temperature was higher from the first charge onward, than in the two-row type, irrespective of the proportion in which the blast was divided between the tuyeres. The steepest rise in temperature of cast iron was observed when 55 per cent. of the blast was supplied through the bottom tuyeres. The maximum mean temperature of the tapped metal, 1,405 deg. C., was obtained for the same ratio. The least satisfactory results were obtained when 57 per cent. of the total blast-volume was supplied through the top tuyere. With fully opened dampers, a higher output and tapping temperature were obtained than with 57 per cent. blast applied through the third tuyere.

Metal Temperature

In the investigation of the influence of the air supply through slit-type tuyeres, as well as the distribution of air between the individual rows upon the tap temperature, use was made of the measurement of mean cast-iron temperatures over a complete run. For short runs (two to three hours) this temperature is not typical since the furnace achieves thermal equilibrium, only at the end of a run. For instance, in the case when 58 per cent. of the blast was supplied into the bottom slit-tuyere of a three-row cupola, the mean temperature of metal was 1,405 deg. C. and the temperature at the end of the run 1,450 to 1,460 deg. C.

The redistribution of the supply of blast through the individual tuyeres during the melting process is caused by the supply of large proportions of cold air through the first tuyere. Slag flowing past this tuyere is intensely cooled and partly clogs the opening, reducing the air flow. Both top tuyeres escape being blocked because they are kept hot by gases rising from the first tuyere. The results obtained in running the three-row cupola with all three dampers wide open were of particular interest (all three tuyeres being of equal area). It was found that the volume of blast passing through each of the three tuyeres was the same. This can be explained by the different height of coke and metal columns above the individual tuyeres, the first being 15-in. below the third.

*An abridged translation from *Liteinoe Proizvodstvo* (a Russian foundry journal).

BTH Annual Review

In the general introduction to the review of the British Thomson-Houston Company, Limited, it is stated that during the past year records have been established for certain of the company's products in the number of orders received, in the amount of equipment manufactured and in the number of installations commissioned. Important advances have been made, it is reported, in the fields of nuclear-power plant, industrial equipment, and electronics.

A considerable number of orders has been received during the year for compressors, boosters and exhausters. One of the most important covers the supply of the largest blast-furnace turbo-blower to be made by the company for installation overseas. The contract, which also includes condensing plant, is for the Algoma Steel Corporation of Canada. The plant is normally rated at 85,000 cub. ft. per min., 30 lb. per sq. in., but will be capable of dealing with a maximum volume of 100,000 cub. ft. per min., at a discharge pressure of 20 lb. per sq. in. The machine will be equipped with the most modern form of volume regulation and anti-surging controls. As a result of extended factory capacity made available during the year, it has been possible to devote greater attention to the manufacture of furnace transformers, and several important orders have been completed during 1957. These include transformers ranging from 800 to 3,500 kva. in rating, all of which are fitted with " off-circuit " tap-changing gear. The largest arc-furnace transformer to be manufactured by the company is nearing completion and will be ready for commissioning early in 1958 for the English Steel Corporation, Limited, Openshaw. The transformer is rated 10,000 kva and is fitted with " on-load " tap-changing gear of the resistance bridging type. All of the above furnace transformers and a number on order for furnace duty are being supplied through Birlec, Limited, an associated company.

Electrical Heating, Furnaces, and Cranes

Throughout the major steel-using countries, the review continues, there seems to be an increasing trend towards the use of electric-arc furnaces, instead of methods which were previously considered more conventional for large capacity melting. Ample evidence of this was shown at the Stocksbridge works of Samuel Fox & Company, when Lord Chandos officially started up an 80-ton Birlec arc furnace—the largest ever to be manufactured or installed in this country. BTH supplied equipment for automatic amplidyne control of the three-phase electrodes incorporating—apart from the usual three amplidyne motor-generator sets and control gear—an additional motor-generator set and changeover switch panel.

Following this contract, another example of large capacity steel-melting equipment is a 30-ton Birlec furnace for English Steel Corporation, Limited, for which BTH has received the order for complete electrical equipment, including a 10 mva. furnace transformer for automatic electrode-control. During 1957, BTH supplied sub-station equipment for a Birlec 2-ton coreless induction melting furnace plant for the production of special alloy steels for the expansion programme of Lloyds (Burton), Limited.

The review states that orders for the company's Stacreep equipments continue to be received in large numbers, and this equipment has been ordered for use in both Berkeley and Bradwell nuclear power-stations. Collimit, the BTH-Patented anti-collision safety device for cranes is operating on two cranes working on the same track in a fettling shop at the works of the Britannia Iron & Steel Company, Limited, Bedford.

American Letter

Iron Castings Sales Recede

Sales of iron castings in the US during 1957 fell, it is estimated, 10 per cent. below those recorded for 1956. The monthly average figures up to the end of September reveal a marked decrease and the trend will, it is calculated, have resulted in a drop over the whole year of 1,100,000 short tons for iron, 160,000 short tons for steel and 80,000 short tons for malleable iron. Copper-base alloy castings were down in 1957 by an estimated 99,000 short tons; aluminium castings recorded a total decrease of 72,000 short tons; magnesium castings fell by 6,000 short tons; zinc-base alloy castings were down by 74,000 short tons.

Table I gives further details of these decreases and includes for purposes of comparison figures for the three years 1955-1957.

TABLE I.—*U.S. Casting Statistics*, 1955-56-57 (*short tons of 2,000 lb.*).

	1955.	1956.	1957.*
Cast Iron and Cast Steel—Total Dispatches—			
Grey iron	14,838,000	13,861,000	12,760,000
Spheroid-graphite iron	No data	No data	120,000
Steel castings			
Total	1,530,000	1,932,000	1,772,000
Carbon—Total	1,084,000	1,445,000	1,337,000
Alloy—Total	446,000	487,000	435,000
Malleable dispatches			
Total	1,105,000	952,000	867,000
Ferritic	—	813,000	743,000
Pearlitic	—	139,000	124,000
Consumption—Raw materials			
Foundry coke	3,154,000	2,850,000	2,524,000
Pig-iron—Consumption by furnace			
Cupola	5,327,000	4,430,000	3,487,000
Electric	246,000	190,000	203,000
Air furnace	260,000	242,000	183,000
Copper-base Alloy Castings	1,009,000	966,000	867,000
Brass and Bronze Ingot Alloy Dispatches	298,000	274,000	248,000
Aluminium Castings	827,000	795,000	720,000
Magnesium Castings	27,800	36,000	30,000
Zinc-base Alloy Castings	778,000	694,000	620,000

* Based on statistics for nine months plus estimates for last quarter of year.

India to Make Power Tools

Last month the foundation stone was laid in Bombay for work to commence on a new factory for the manufacture of pneumatic power tools and plant. It will be the first full scale production unit in the country to specialize in the field of compressed air. It is the outcome of plans developed by the Consolidated Pneumatic Tool Company, Limited, of London. The programme covers the production of full ranges of Consolidated Pneumatic tools including rock drills, concrete breakers, picks, pumps and compressors. The new factory is located at Muland on the outskirts of Bombay, and is expected to be completed about the middle of this year. The new manufacturing centre will be operated by Consolidated Pneumatic's Indian subsidiary, the Consolidated Pneumatic Tool Company, India (Private), Limited. The stonelaying ceremony took place in December and was performed by Mr. Norman Readman, managing director of Consolidated Pneumatic, London.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

WARRINGTON, February 10—Materials required by County Council during 12 months ending March 31, 1959, include cast-iron manhole covers and frames and gully gratings and frames (No. 16). Specifications, etc., from Borough Engineer and Surveyor, Town Hall, Warrington, stating form number required.

HALIFAX, February 8—Supply of materials for Halifax Corporation, including castings (manhole covers and frames, gully gratings, etc.). Forms of tender, etc., from the Borough Engineer, Crossley Street, Halifax.

METROPOLITAN WATER BOARD, February 6—Supply of cast and spun-iron straight pipes, cast-iron specials (No. 3). Tender forms from the Chief Engineer, Offices of the Board (Room) 171), New River Head, Rosebery Avenue, London, E.C.1.

POOLE, February 17—Following for year ending March 31, 1959:—Iron castings, manhole covers, etc (serial No. 17). All applications to Borough Engineer, Municipal Buildings, Poole, accompanied by a stamped addressed envelope.

PETERBOROUGH, February 11—Supply and delivery of various unilateral and no waiting signs, etc., and components. Form of tender, specification and schedule may be obtained from the City Engineer, Mr. L. H. Robjohn, P.O. Box 10, Town Hall, Peterborough.

BARNSLEY, February 18—Supply of cast-iron manhole covers and gully gratings. Documents from the Borough Engineer and Surveyor, Town Hall, Barnsley.

BIDDULPH, February 10—Supply of the following for Urban District Council for the year commencing March 31, 1958:—Cast-iron goods—manhole, gully, valve covers. Documents from the Surveyor and Water Engineer, Council Offices, Biddulph, Stoke-on-Trent, accompanied by a stamped addressed foolscap envelope.

HEMEL HEMPSTEAD, February 17—Requirements for Borough Council include:—Heavy castings—manhole covers, gullies, etc.; light castings—hydrant covers, valve covers, etc,, and cast-iron pipes and specials. Tenders, in sealed envelopes, endorsed with the name of the materials to be supplied, and bearing no name or indication of the sender, to C. W. G. T. Kirk, Town Clerk, Town Hall, Hemel Hempstead, Herts.

SLOUGH, February 10—Supply of cast-iron manhole covers and frames and gully grates and frames, for Borough Council (Ref. No. 7). Tenders, in plain envelopes, endorsed "Annual Tenders, Ref. No. ——," to Norman T. Berry, Town Clerk, Town Hall, Slough.

WILLITON, February 24—Reconstruction of sea outfall sewer and training groynes at Porlock Weir. Tenders are invited for the following constructional work:—32 yd. of 9-in. dia. spun-iron sea outfall sewer and 85 yd. of training groynes. Drawings and conditions of contract will be available for inspection at the office of the Engineer and Surveyor, Mr. S. E. Balch, Council Offices, Fore Street, Williton, and the form of tender, specification and bills of quantities can be obtained from the Engineer upon payment of a deposit of two guineas, by cheque, which will be refunded upon the receipt of a bona-fide tender and the return of all documents.

LEIGH, February 8—Requirements include castings. Documents from the Borough Engineer and Surveyor, Town Hall, Leigh, Lancashire.

ASHFORD (KENT), February 7—Supply of C.I. manhole covers and street gully covers (Contract No. 7), for Urban District Council. Documents from the Surveyor, 1, Elwick Road, Ashford, Kent, stating the contract(s) in which interested and enclosing a 6d. stamped addressed envelope.

BORDER R.D.C.—Providing and laying of approx. 785 lin. yd. of 3-in. dia. water main and 95 lin. yd. of 4-in. dia. water main in Class B spun cast-iron, together with the necessary valves, fittings, etc., for Brampton Water Supply. Contractors with the necessary experience, plant and personnel, desirous of tendering, should submit their names and addresses, together with deposit of £2 2s., to the Council's Engineer, 7, Victoria Place, Carlisle, on receipt of which the necessary specifications and bill of quantities will be forwarded.

ASHINGTON, February 15—Following for 12 months ending April 1, for Urban District Council:—Cast-iron street gullies, manhole covers and frames. Documents from the Surveyor, Town Hall, Ashington.

BERKSHIRE, February 14—Following for the year ending March 31, 1959:—Cast-iron manhole covers, gullies and frames. Documents from the County Surveyor, Shire Hall, Reading.

BLYTH, NORTHUMBERLAND, February 8—Supply of cast-iron gully grates and frames, gullies, manhole covers and step irons, for Town Council. Documents from the Borough Engineer, Municipal Buildings, Blyth.

CROMPTON, LANCS, February 10—Requirements of Urban District Council include iron castings. Documents from the Engineer and Surveyor, Town Hall, Shaw.

MERTHYR TYDFIL, GLAM, February 8—Supply of iron castings. Documents from the Borough Engineer and Surveyor, Town Hall, Merthyr Tydfil.

Company News

BAKER PERKINS, LIMITED, food machinery manufacturers, founders, etc., of Peterborough—The directors announce that profit shares, which under the company's profit-sharing schemes have, for the past 10 years, been paid to employees in cash, will in future, at the discretion of the directors, be satisfied by the issue of £1 ordinary units at market price. The distribution in stock in respect of 1957 is expected to be made next April or early May.

BABCOCK & WILCOX, LIMITED—Terms have been fixed for the £2,000,000 6 per cent. debenture stock, 1980-83, issue. It is being offered to members and debenture holders registered on December 27, 25 per cent. being payable on application by February 11, 25 per cent. by March 7, and the remainder by April 15. The issue with the already announced rights offer of 1,881,099 £1 ordinary shares, forms part of an operation to raise some £3,800,000.

EDGAR ALLEN & COMPANY, LIMITED, steelmakers, of Sheffield—An interim ordinary dividend of 5 per cent. has been announced. For the year ended March 30, 1957, a single dividend of 12½ per cent. was paid. Group turnover and profits, before tax, for the half-year to September 30 compared favourably with those of the corresponding period of 1956, and the directors believe that on the results for the full year they will be in a position to recommend a final dividend of 7½ per cent.

CRONITE FOUNDRY COMPANY, LIMITED—Further progress this year in the absence of a world-wide trade depression or major political disturbance is anticipated by the chairman, Mr. A. P. Hague. He reports a healthy order-book and says that there is no need to worry about the Bank rate as the company is well able to finance activities and forseeable capital expenditures out of resources. In connection with the planning of the first section of the new foundry in Somerset, special modern-type melting and auxiliary equipment is now due for delivery. It is hoped to have the new buildings completed in May. After tax of £72,042 (£54,730), the net profit expanded from £60,158 to £65,636 in the year ended September 30 last. The dividend is raised from 22½ per cent. to 30 per cent.

British Exhibit at Cleveland

Foundry Equipment, Limited, of Linslade Works, Leighton Buzzard, Bedfordshire, believe if a thing is worth doing, it is worth doing well. The firm has taken one of the largest stand spaces at the forthcoming foundry show to be held in Cleveland, Ohio, from May 19 to 23. The stand numbers are 2,046-52 and 2,143-47, and on them there is to be shown a full range of working models of either completely new or the latest versions of standard plant which will be, wherever possible, automatic.

Eleven members of the staff will be on the stand, including directors, sales, technical, operating and maintenance personnel. The stand will be operating under the name of their new north American division—F.E. (North America), Limited, 185, Eileen Avenue, Toronto 9, Canada. It is to be hoped that this British example of commercial enterprise will reap rich rewards.

Book Reviews

History of the British Iron and Steel Industry, by H. R. Schubert. Published by Routledge & Kegan Paul, Limited, Broadway House, 68-74, Carter Lane, London, E.C.4; price 60s. net.

Whilst in the past there have been a number of valuable contributions to history of early iron and foundry developments in books covering, for instance, the iron industry of the Weald and gunfounding, this one is the first to deal comprehensively with the subject from prehistoric times to the introduction of steam power.

Wisely, the author differentiates between the periods when a malleable iron was the end product and later when pig- or cast iron was produced for final treatment and decarburization in a separate forge. Recent correspondence in the JOURNAL points out that during the earliest stages the accidental production of pig-iron was a nuisance, and this is one explanation why it received such an uncomplimentary name. When the development reached the pig-iron stage, the ironmaking and foundry industries were very closely associated and this makes the book equally interesting for anyone delving into the history of either wrought or cast iron. The chapters which have a major interest for foundrymen are No. 10 *et seq.* The word " Irone founders," we are told, first appeared in 1490.

The book runs to nearly 450 pages. It is well written and is extremely well documented with references. The numbers drawing attention to these are not too obtrusive and scarcely distract the reader from the text, as in some works of reference they most certainly do. There are no fewer than 18 appendices, one of which (No. VIII) carries some fine pictures of cast-iron firebacks. The illustrations, both as to choice and quality of reproduction, are excellent. The research expended on amassing the vast amount of information disclosed in this book together with its splendid presentation is such as to make this a standard work for a very long time.

V. C. FAULKNER.

Strength of Materials, by F. R. Shanley. Published by McGraw-Hill Publishing Company, Limited, 95, Farringdon Street, London, E.C.4; price 64s.

The subject of the strength of materials is still considered as subsidiary in some university and college courses of metallurgy. Not many good reasons could be given in defence of such an arrangement, except perhaps, that the syllabus of these courses is already crowded. Another reason frequently advanced is that the subject of the strength of materials is of more direct interest to the users of metallic (and other) materials, *i.e.*, the engineer, than to the producer of such materials, *i.e.*, the foundryman or the metallurgist. But neither of these nor any such arguments can nullify the fact that the majority of metallic structures are used to-day under some type of load or other, and that therefore the producer should master the theory of the strength of materials at least to the extent to be able to converse intelligently with an engineer.

The present book provides an admirable introductory treatment to the subject of the strength of materials which could be profitably read by all students of metallurgy. It is broadly divided into three sections. The first deals with the basic concepts: forces, elasticity, deformation and stress/strain analysis. This part is essential for any metallurgist who wishes to have a grasp of the behaviour of metal under stress. The second part deals with the analyses of stresses, strains and deflections in the basic types of engineering structures, but mainly comprising the beams under various types of loading. This part is more " engineering " than " metallurgy "—but the occasions when a metallurgist is called upon to calculate the dimensions of a structural component are frequent enough to justify the inclusion of this part of text for, at least, university degrees in metallurgy. The last section of the book is more decidedly engineering and deals with the more " difficult " type of structures, and mainly columns.

The subject matter of the theory of the strength of materials is one which resembles a good deal the subject of thermodynamics. Either could be made so readily enveloped into the mathematical jargon that it leaves most, but the more mathematical minded student, " cold " from the start. That this is unnecessary, and in general quite faulty for an introductory treatment, is well illustrated by the present book. The concepts are here lucidly explained, the basic mathematical relations are clearly developed and formulated and finally, and what is most essential, the application of relations obtained is fully discussed and illustrated with numerous examples. In brief, metallurgists, even of the old school, could hardly fail to either understand or enjoy this first-class textbook. This is mainly due to the fact that the author keeps the metallurgical aspect of the subject in front of the reader practically throughout the text. The book has decidedly a metallurgical flavour.

V. KONDIC.

Publications Received

Metal Statistics 1947-1956. 44th Annual Issue. Published by Metallgesellschaft Aktiengesselschaft, Reuterweg 14, Frankfurt am Main, Germany.

In this well-bound, 234-page book, world business in aluminium, lead, copper, zinc and tin is covered in a series of statistical tables. Much of the information contained is normally quite difficult to locate, such as for instance, the quantity of copper exported to Australia during the last decade. The tables cover production, consumption, exports and imports. The indexing, which is so important in reference books of this character, is impeccable. In addition to the largely used metals, there are notes on the production of cadmium, magnesium, nickel, mercury and silver. During the last decade, most of these metals have seen their production doubled, with the exception of mercury which has risen only about 13 per cent. Recipients of this excellent publication can indeed count themselves fortunate.

Iron and Steel Trades in 1957. A special review published by William Jacks & Company, Limited, Winchester House, Old Broad Street, London, E.C.2.

For several years the reviewer complained that this annual review ignored the ironfounding industry. This year it is dealt with and, what is more, is very well done. Moreover, there is a hint given that because iron castings vary so much in type, the output figures do not tell the complete story.

AN ORDER for two units of Segas plant (three vessel design), each capable of manufacturing 2,000,000 cub. ft. of town gas daily using heavy oil or light distillate as feedstock, has been awarded to the Power-Gas Corporation, Limited, by Stockholm Gas and Water Works. Power-Gas states that this is the first large oil gas plant for the manufacture of town gas to be ordered for Scandinavia.

News in Brief

IT IS ANNOUNCED that Qualcast Limited, Derby, are to instal a £120,000 automatic-moulding plant in one of their foundries, in the near future.

NU-SWIFT, LIMITED, makers of fire-fighting equipment, claim that sales in 1957 constituted an all-time record and included £250,000 worth of export business.

BUTTERLEY COMPANY, LIMITED, of Ripley, have received a contract from British Railways for the reconstruction of the superstructure of a bridge at Acton, London.

MECHANIZED COMPOSTING PLANT for use in Bangkok, Thailand, is to be supplied by John Thompson, Limited, Wolverhampton, under a £714,000 contract recently signed.

THE eighth annual presentation of long service awards was held in the canteen at the works of J. Blakeborough & Sons, Limited, valve makers, Brighouse, on January 17. This year there were 14 recipients, bringing the total to 522.

OY WITRAKTOR A-B, Caterpillar Tractor Company's Finnish dealer, opens an extensive new showroom in Helsinki this weekend and Mr. D. F. Shinn, sales manager of Caterpillar Tractor Company, Limited, is flying to Scandinavia for the formal opening ceremony on Friday.

LANCASHIRE DYNAMO CENTRAL AFRICA (PVT.) LIMITED, a member of the Lancashire Dynamo Group, is taking over premises at Kopje, Salisbury, Southern Rhodesia. From February 1, the new address of the company will be : 93, Coventry Road, P.O. Kopje, Salisbury, S. Rhodesia.

THE REPORT of the conference on "NIFES Third Progress Survey" held by the Combustion Engineering Association at Harrogate on November 5 and 6 is now available. Copies may be obtained from the Association at 6, Duke Street, St. James's, London, S.W.1; price £1 1s. 0d.

MATERIALS HANDLING EQUIPMENT (GREAT BRITAIN) LIMITED, of 40a, Dover Street, London, W.1, announce that they have received from the Indian Government Purchasing Mission a contract for the supply of a number of Irion side-operating fork-lift carriers of 3 and 5 tons capacity for use in the Port of Calcutta.

AS A RESULT of the recent Caribbean tour by their export sales manager, Saunders & Forster, Limited, of 3, Buckingham Palace Gardens, London, S.W.1, structural steel specialists and manufacturers of standard steel buildings, have decided to establish a Caribbean office at 31, Charlotte Street, Port of Spain, Trinidad.

ARGENTINA has placed an order worth £1,000,000 with Aveling-Barford, Limited, Grantham (Lincs), for 170 road-building 10-ton motor graders and spare parts. This is the largest single contract for motor graders ever placed outside the US, and will keep grader production lines at Grantham fully occupied until 1959.

ABOUT 80 EMPLOYEES of H. J. Enthoven & Sons, Limited, lead refiners, South Darley, Derbyshire, were given a fortnight's notice on January 17. Some of the work previously carried out at the works will be done in future at the company's plant at Rotherhithe, London. Only part of the Darley Dale works is affected.

OIL FEED ENGINEERING COMPANY, LIMITED, of 18, Denbigh Street, Victoria, London, S.W.1, for many years manufacturers of high-pressure flexible hose assemblies under the well known "Hi-Flex" trade mark, has now become a member of the BTR group of companies and will operate as the high-pressure hose division of the group.

PROTECTIVE VACCINE is being offered to its workers by the Glacier Metal Company, Limited, Kilmarnock, to guard against the possibility of another influenza epidemic. Of more than 1,000 workers on the company's payroll, 800 have already submitted to voluntary inoculation by the company's doctor. One in every three workers was affected by the recent epidemic.

DURHAM RAW MATERIALS, LIMITED (1/4, Great Tower Street, London, E.C.3), and J. M. Huber, Limited (6, Great Winchester Street, London, E.C.2), announce that, as from January 1 Durham Raw Materials, Limited, have been appointed distributors in the United Kingdom of materials manufactured by the J.M. Huber Corporation, 100 Park Avenue, New York, 17.

AT THE ANNUAL MEETING of the Sheffield Metallurgical Association on January 21, the following officers were elected: Mr. R. C. Baker, as president; Prof. A. G. Quarrell, Mr. W. C. Heselwood, Mr. J. E. Russell, and Dr. A. H. Sully, vice-presidents; Mr. P. Mitchell, secretary; Mr. J. Burnett, treasurer; and Mr. T. G. Chadwick, librarian. It was announced at the meeting that membership of the Association had risen to 318.

BRITISH INDUSTRIAL SAND, LIMITED, have opened a northern-area office at 47, Pilgrim Street, Newcastle-upon-Tyne, 1 ('phone 21528) to handle the sales on the North-East Coast and in Scotland of their established sands from Redhill and King's Lynn quarries and from their new quarry at Castleton, near Whitby. Mr. B. J. Kirkman, northern-area sales manager, will be in charge of the new office, and will also deal with sales of Feslente resin-coated sands in these areas.

THOMAS SMITH & SONS (RODLEY), LIMITED, crane and excavator manufacturers, Rodley, near Leeds, have announced that following a recent tour by their joint managing director, Mr. W. H. Sharp, they have secured a contract for the supply of 27 diesel and steam cranes, valued at just under £300,000, to the Indian Government for the Indian State Railways. This is the third successive year this firm has received big orders from India. In 1955 they obtained an order for about £250,000 from the State Railways, and in 1956 for close on £300,000 worth of cranes.

A WEEK-END CONFERENCE for foremen and shop stewards, with the theme "Conflict or Co-operation?" has been organized by the Industrial Welfare Society to take place at the Hotel Majestic, St. Annes-on-Sea, from February 28 to March 3. The Society also announces that a course for junior executives and management trainees will be held at Robert Hyde House from March 3 to 7. Those wishing to attend either event may obtain details from Mrs. O. K. Skelley, administrative officer of the Society, at Robert Hyde House, 48, Bryanston Square, London, W.1.

WHEN the Star Aluminium Company, Limited, of Wolverhampton, received a "rush" order for 10 tons of aluminium-foil from a firm in Sydney, a stipulation in the contract was that the consignment should be aboard a ship leaving Tilbury for Australia on January 18. The order was completed, packed in 24 cases and despatched on its way south, but on the way to the docks the articulated lorry on which it was being transported crashed down a 14-ft. embankment. Mr. H. M. Hurst, managing director of the firm, said that the foil would be remelted and remade and consigned to Sydney at a later date.

News in Brief

SOME 19½ PER CENT. MORE BUSINESS was covered during 1957 by the Export Credits Guarantee Department "commercial" insurance than in the previous year. Goods declared as shipped under ECGD cover reached the record figure of £485,400,000, compared with £409,400,000 in 1956. New medium term transactions insured during the year reached the record figure of £156,600,000, compared with £77,500,000 in 1956 and £42,300,000 in 1955. The number of short term policies current increased during the year from 4,112 to 4,326, although the face value of current policies declined from £546,600,000 to £518,600,000.

SPARTAN STEEL & ALLOYS, LIMITED, Spartan Works, St. Stephens Street, Birmingham 6, a company recently formed, has taken over from Leopold Lazarus, Limited, as from January 1, the manufacture and marketing of their specialized iron and steel products in the United Kingdom. In every other respect, Leopold Lazarus, Limited, will continue to trade as previously. The members of the board of Spartan Steel & Alloys, Limited, are Mr. M. Lissauer, Mr. F. A. Lissauer, Mr. E. Josephs, Mr. A. A. Lazarus, Mr. H. J. Rothschild, (all of whom are members of the board of Leopold Lazarus, Limited) Mr. Z Stokowiec and Mr. G. Wax.

WAVERLEY FOUNDRY COMPANY, LIMITED, recently made an appeal at Oldbury Valuation Court for the rateable value of their foundry, at the junction of Stone Street and Green Street, to be reduced from £600 to £435. Mr. Neal, of Sellars & Company, auctioneers and surveyors, of Freeth Street, Oldbury, who appeared on behalf of the company, said that the main foundry was separate from the cupola and the molten metal had to be carried out by manual means, with the result that many castings were ruined. No cranes or gantries were installed. Also, the site of the foundry was a sloping one, and parts of the ground were liable to flooding in wet weather, and as there were no roof lights artificial lighting had to be used all the time, day and night. The panel decided to reduce the rateable value to £525.

THE INCREASE of 4,000 in the total of unemployed in the Midlands, making 25,000 unemployed in the past month, was said by Mr. J. W. Eldridge, Regional Controller for the Ministry of Labour, at a meeting of the Midland Regional Board for Industry in Birmingham, to be a seasonal increase, "the figure of 4,000 was the normal pattern and was spread over most industries." On the state of trade generally, Major C. R. Dibben, chairman of the Board, said that trade had been well maintained in the region and for the next few months there was no indication of any great change one way or another. The number of workers in the Midlands affected by short-time working was 4,800, a figure well below the total early last year—only 265 were now on short-time in the motor industry. It was also reported that school leavers were not getting jobs so quickly as in the past.

MEN AT CARRON IRONWORKS, Falkirk, who at one time had had to work Sunday shifts were now able to complete their work in the normal week because a system of time assessments had been introduced. Mr. J. S. Stewart, district organizer of the Amalgamated Union of Building Trade Workers, said in Edinburgh recently. He was giving a talk to men taking part in the five-day work-study exercise promoted by Edinburgh and South-East Scotland Productivity Committee, of which he is also chairman. He agreed that it was not easy to apply methods of higher productivity equally to all trades. In maintenance work it was particularly difficult, but it had been done at Carron Works. The trade unions, he said, had to support new technological methods and greater productivity, because it gave their members hope of a better standard of living.

Mr. E. M. CLAYSON speaking at the annual dinner of the British Jewellers Association said that while businessmen accepted in principle the economist's argument that too much capital expenditure was a source of great danger, those who dealt with the men in the workshops were convinced that the surest cause of inflation was the rising cost of raw materials, transport and labour. What the country needed above all things was the stabilization of costs and especially a stabilization of wage rates. There was also the inflationary aspect of the taxation of industry which wanted better capital allowances for tax purposes on plant and new buildings. At present industry often suffered through the temptation to make do with poor and inefficient patched-up plant and buildings because the heavy maintenance cost is allowable for tax purposes and therefore shared by the Treasury. Mr David H. Wright, the president of the Association, urged a reduction of purchase tax to a "workable" level. If action was not taken soon, he said, the time was near when there would be no craftsmen left in the jewellery and precious metalware trades and export trade of great value to Britain would be lost with little chance of ever regaining it. It almost seemed as if the firms which made an effort to export their products were penalized by having their home market restricted. A manufacturer in Britain had no chance of testing market reaction to a new product. If he made up special pieces for export, and they were unsuccessful, they had to be broken up because purchase tax made it impossible for them to be sold in this country. He added that the British manufacturer was losing heart and interest in an attempt to maintain overseas trade.

Obituary

The death took place on January 19 of Mr. ARCHIBALD MCMILLAN, a partner in Archd. McMillan & Company, coppersmiths and brassfounders, of Edinburgh.

The death has occurred at the age of 52 of Mr. TOM BELLAMY, who was a chief estimates clerk at the Mushet works of Samuel Osborn & Company, Limited, the Sheffield steelmakers.

Mr. CHARLES FOX-PARKER, sales manager of William Mills, Limited, aluminium founders, of Wednesbury (Staffs), and formerly of the British Aluminium Company, Limited, died on January 18 at the age of 45.

Mr. GEORGE ARTHUR FIRKINS, Midland consulting engineer and chairman of the Wolverhampton branch of the Institution of Production Engineers, died on January 19 at the age of 56. Mr. Firkins was formerly manager of the Red Wing Aircraft Company, Wolverhampton, and later founded the firm of G. & A. Firkins, engineers.

Mr. G. AUTERSON, principal electrical engineer surveyor to Lloyd's Register of Shipping, has died at the age of 46. His death was the result of a car accident. Mr. Auterson gained a B.SC. degree with first-class honours at Belfast University, and joined the Metropolitan-Vickers Electrical Company, Limited, in 1935. He was responsible for electrical standards in the company's standards laboratory and, later, for instrument and relay orders and tenders in the meter department. He joined Lloyd's Register in 1936 and after serving at Sunderland and headquarters was appointed senior surveyor in 1948. He was appointed to his last position in 1956.

Forthcoming Events

FEBRUARY 1

Institute of British Foundrymen

Lancashire branch:—"Iron and Steel Foundry Regulations," by E. Waller, 3 p.m., at the Midland Hotel, Manchester.

FEBRUARY 3

Institute of British Foundrymen

Sheffield and district branch:—"Application of the CO_2 Moulding Method," by T. C. Wilson, 7 p.m., at the Sheffield College of Commerce and Technology Department of Engineering, Pond Street.

FEBRUARY 4

Institute of Metals

South Wales local section:—"Secondary Metal Recovery," by H. J. Miller, M.Sc., F.I.M., 6.30 p.m., at the Department of Metallurgy, University College, Singleton Park, Swansea.

Institution of Works Managers

Leicester branch:—"Planned Maintenance," by A. R. F. Steadman, 7.30 p.m., at the Lecture Theatre, Loughborough College, Greenclose Lane, Loughborough. (Joint meeting with Notts. and Derby branch.)

Incorporated Plant Engineers

Edinburgh branch:—"Testing of Engineering Materials, Destructive and Non-destructive, by Mechanical, Chemical, X-ray and Ultrasonic Means," by J. A. Menzies, 7 p.m., at 25, Charlotte Square.

FEBRUARY 5

Incorporated Plant Engineers

Leicester branch:—"Trade Waste Effluents," by S. J. Roberts, B.Sc., 7 p.m., at the Bell Hotel.

Institution of Production Engineers

Nottingham section:—"Metallurgy in Production," by H. D. Ward, 7 p.m., at the Victoria Station Hotel.

FEBRUARY 6

Institute of Metals

Birmingham local section:—"Porous and Infiltrated Metals," by J. E. Elliott, 6.30 p.m., at the College of Technology, Gosta Green.

Incorporated Plant Engineers

Glasgow branch:—"Some Factors concerning Works Capital Expenditure," by F. Franklin, 7.15 p.m., at the Scottish Building Centre, 425/427, Sauchiehall Street.

Institution of Production Engineers

Viscount Nuffield paper: "Technical Education for Production Engineers," by Lord Hives, 6.30 p.m., at the University of Bristol.

Luton section:—"Shell-moulding Process," by D. N. Buttrey, 7.30 p.m., at the North Herts. Technical College, Letchworth.

Institute of British Foundrymen

Stoke-on-Trent section:—"Aims to Production in the Jobbing Foundry," by I. Rees, 7.30 p.m., at the Stipendiary Court Room, Town Hall, Hanley.

FEBRUARY 7

Tees-side branch:—"Foundry Maintenance," by P. W. Pegg, 7.30 p.m., in the Teesdale Hall of Head Wrightson & Company, Limited, Thornaby.

Newcastle branch:—Annual dinner, 7.15 for 7.45 p.m., at the Royal Turks Head Hotel.

Association of Bronze & Brass Founders

Midland Area:—"European Common Market and Free Trade Area," by M. H. Fisher, 7 p.m., at the Birmingham Exchange & Engineering Centre, Stephenson Place.

FEBRUARY 8

Institute of British Foundrymen

Bristol and West of England branch:—Annual dinner, 6.30 for 7 p.m., at the Grand Hotel, Bristol.

East Midlands branch:—"Production Problems in the Manufacture of Alloy-iron Castings," by W. M. Lord, B.Sc.Tech., 5 p.m., at the College of Technology and Commerce, Leicester.

Newcastle branch:—"A Small Green-sand Steel Foundry," by W. Wilson, 5 p.m., in the Neville Hall, Westgate Road.

Scottish branch:—"Some Notes on the Production of Steel Castings," by W. P. Brown and A. McCulloch, 3 p.m., at the Royal Technical College, George Street, Glasgow.

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Personal

Mr. ERIC MENSFORTH, a director of John Brown & Company, Limited, Sheffield, and of Rhodesian Alloys, is to visit Rhodesia in March.

Mr. V. C. FAULKNER removed from 21 to 15 Crescent Court, Surbiton, on January 28. His telephone number, which is not in the London guide but appears in the Surrey edition, remains at Elmbridge 1496.

Mr. PHILIP R. PRIOR, director and general manager of the Worcester Brass Company, Limited, has been appointed managing director. He succeeds Mr. G. R. PRIOR, who has retired but remains in an advisory capacity.

Mr. JOHN CARLE has been appointed to the boards of Tilghman's, Limited, manufacturers of shot-blast plant, etc., of Altrincham (Ches), and of George Richards & Company, Limited, machine-tool makers, etc., of Altrincham.

Dame FLORENCE HANCOCK, D.B.E. and Brigadier J. J. SLOAN, O.B.E., M.C., have been appointed directors of Remploy, Limited, the company established by the Government to provide sheltered employment for severely disabled persons.

Mr. SPENCE SANDERS has resigned the chairmanship of the Fulmer Research Institute on his retirement from the board of directors of Almin, Limited. His place as chairman has been taken by Mr. W. R. MERTON. Mr. J. G. GRAHAM has been appointed to the board of directors.

British Road Services announce the appointment of Mr. E. T. CROKER, district traffic superintendent, Gloucester district, western division, as district manager, Gloucester district. Mr. Croker succeeds Mr. T. W. THOMAS, who has relinquished his appointment owing to ill health.

Mr. G. E. LIARDET becomes chairman and managing director of the recently formed Simms Motor and Electronics Corporation and relinquishes his position as managing director of Simms Motor Units, Limited, though retaining the chairmanship of the board. In turn, Mr. J. AYRES is appointed managing director of Simms Motor Units.

Mr. WALTER SAMPSON, a director and general manager of Thos. W. Ward (Australia) Pty., Limited, of Sydney, a subsidiary of Thomas W. Ward, Limited, Sheffield, arrived in this country by air this month. He is on a visit to the parent company to report and discuss progress and developments. He will stay in Britain for six weeks.

Mr. WILLIAM BLACKIE, president of the foreign-trade group of the Caterpillar Tractor Company, of Peoria, Illinois, and an executive vice-president of the company, has been elected to fill one of two vacancies on the board of directors. Mr. Blackie, who is 52, was born and educated in Glasgow. He is a former chairman and still a member of the board of the Caterpillar Tractor Company, Limited, Glasgow, the American firm's British organization.

Mr. D. L. CAMPBELL has been appointed managing director (sales) of the Metallurgical Equipment Export Company, Limited, of 19, Victoria Street, S.W.1. This organization is a consortium of leading companies engaged in the manufacture of steelworks plant, and through its associated company, Indian Steelworks Construction Company, Limited (ISCON), is responsible for the general engineering work in connection with the Durgapur Steelworks of India.

Ferrous Castings, Limited, of Warrington, announce the appointments of Mr. W. H. HORNBY, as works manager and Mr. E. F. FARREN to take charge of the production and development of shell moulding. Mr. Hornby was previously works manager of Argus Foundry, Limited, of Thornliebank, Glasgow, while Mr. Farren was previously foundry manager for the Carron Company of Falkirk. Mr. D. ROBERTSON is the managing director of Ferrous Castings, which is one of the Metal Industries group of companies.

Dr. A. D. MERRIMAN, G.C., O.B.E., D.L., M.A., M.ED., D.SC., C.I.MECH.E., F.R.S.E., secretary of the Institution of Metallurgists from 1948 until retirement at the end of 1957, has been appointed consultant on scientific projects to Edgar Allen & Company, Limited, steel manufacturers and engineers, Sheffield. Dr. Merriman was born in Manchester in 1892 and studied at the Manchester College of Technology, and the universities of Cambridge, Lille and Durham. Dr. Merriman is deputy-Lieutenant of the City of London.

An extensive tour of Africa is to be undertaken by Mr. H. G. NELSON, managing director of the English Electric Company, Limited. The object of his tour, which begins early next month, is to obtain first-hand impressions of the general economic development of Africa and its projects for the future, as well as to meet customers of the company and visit the large installations—power stations, railways, and mines—that it has equipped there. While in South Africa, Mr. Nelson will officially open the new extension of the company's works at Benoni (Transvaal).

Foundry Services International, Limited, announce the appointment of Mr. B. HOWARD WILLIAMS as general manager of their new associate manufacturing company to be established during the current year within the environs of Sydney, Australia. Mr. Williams, who joined the Foseco organization seven years ago, was originally a technical representative. He was called to the Foseco headquarters in Birmingham, to become senior technical officer and was later appointed commercial manager. Late last year he visited the associate company in Johannesburg, South Africa, on a six-weeks' business trip. Mr. Williams is a member of the Institute of British Foundrymen.

Mr. PERCY HANNIBAL retiring deputy chief inspector of weights and measures for Smethwick, was presented with a suitcase and an electric blanket by Mr. A. Heward, chief inspector at W. & T. Avery, Limited, Birmingham, on January 17. Mr. Heward said: "It is 49 years since Mr. Hannibal first came to the Soho Foundry, and it is estimated that during this long period he will have verified and stamped about half a million scales, in addition to a countless number of weights. I am sure it is safe to say that this is easily a record for any inspector, past or present." The gifts were in appreciation of the fair, firm, and courteous way in which Mr. Hannibal had carried out his duties.

Mr. K. G. LAMPSON has been appointed managing director (sales) of the United Steel Companies, Limited, Sheffield. LIEUTENANT-COMMANDER G. W. WELLS, director and general manager of the Appleby-Frodingham Steel Company and Mr. R. J. BAVISTER, commercial manager of Samuel Fox & Company, Limited, have both been appointed directors of Samuel Fox & Company, Limited. Mr. LAMPSON, COLONEL BENTON-JONES, and Mr. I. M. KEMP, chief design engineer of Appleby-Frodingham Steel Company, have been appointed directors of that company. Mr. R. P. CRAWSHAW, general sales manager and chief purchasing agent of United Steel, has been appointed a director of the United Steel Structural Company, Limited.

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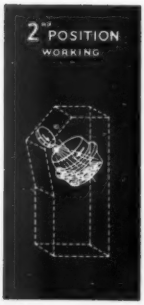

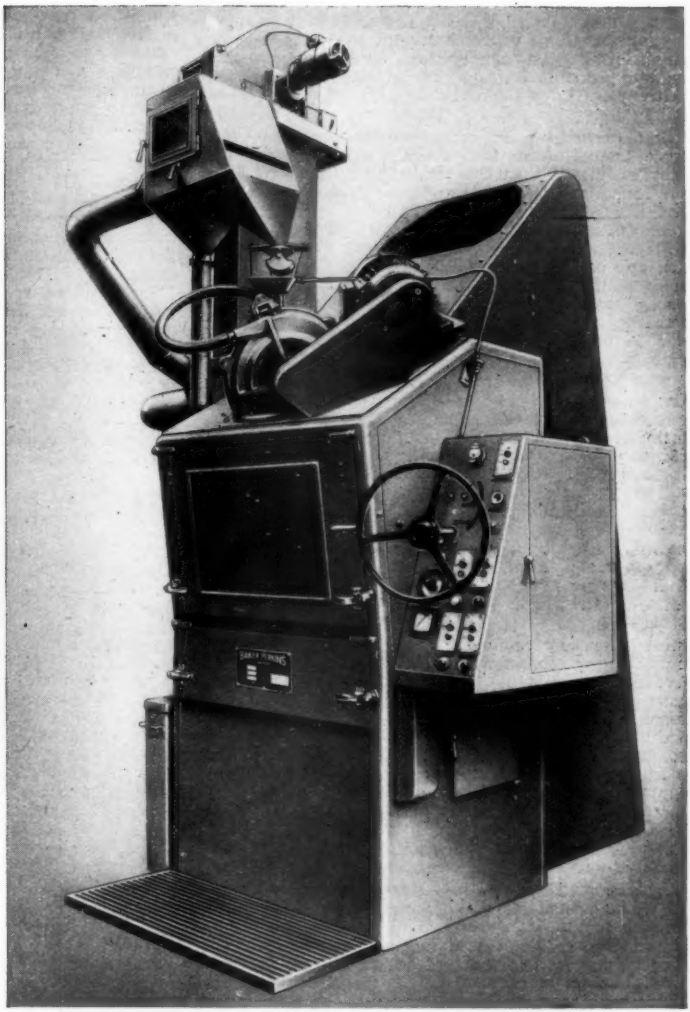

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Raw Material Markets

Iron and Steel

Production of most grades of pig-iron is maintained at high levels and good stocks are held by many furnaces. The steelworks have appreciable tonnages of basic pig-iron in stock, which, together with deliveries, are found adequate. When the position warrants, increased tonnages could be supplied to them from existing furnaces, some of which are not producing to capacity in this grade of pig-iron. The steelworks also hold appreciable tonnages of imported pig-iron, but deliveries will probably be reduced considerably in the future.

In the foundry grades there is no shortage, apart from some brands of the low-phosphorus irons, which are not too plentiful, and to make good this deficiency the foundries are compelled to purchase more expensive irons. Hematite pig-iron is taken up by them in good quantities, and those using the refined grades are amply supplied. High-phosphorus pig-iron is plentiful, and the foundries have no difficulty in obtaining sufficient from current production and from the producers' stocks. There is no necessity for the foundries to carry reserves of iron and forward buying is meagre, due to present economic conditions and also to the scarcity of orders.

The light-castings market continues quiet and, so far as can be foreseen, the immediate future holds out little hope of improvement. The domestic equipment trade is dull and the curtailment in building will continue to have an adverse effect on the demand for castings.

The textile foundries are not specifying their normal tonnages, while many of the jobbing foundries are also only moderately employed. Some of the engineering foundries take up fair tonnages of the high-phosphorus pig-iron, but from some areas come reports that these foundries are not so busy as they were a month or two ago.

The engineering and speciality foundries continue the most favourably employed, and their outputs of high-duty castings for many trades are at a good level. Orders on the books and those now being placed ensure a continuity of production of at least present tonnages for some months ahead. Most of the foundries are well provided with scrap, the chief demand being for the better and heavier grades of cast-iron and machinery scrap. Foundry coke is in fairly good supply, with deliveries generally sufficient to cover consumption needs. Foundry stocks of some brands are small, and relying on current deliveries is risky at this time of the year. Ganister, limestone, and firebricks are obtained to requirements.

The demand for small bars and light sections continues quiet, and many of the re-rollers are adversely affected in that their small mills are not working to capacity. The billets held in stock are lasting much longer than was expected and demands from the steelworks are on a reduced scale. Home suppliers of billets could increase deliveries considerably if required, but in common with other users of raw materials, stocks at the re-rolling mills are being reduced to the minimum required for current output requirements. Forward buying is scarce and it is understood that some of the steelworks cannot dispose of all their rollings of billets and are compelled to place some tonnages into stock. Reinforcing rods, as well as sheets, continue in good demand from the re-rollers, and the call for the larger sizes of bars and sections is also at a fairly good level.

Non-ferrous Metals

Copper, after drifting aimlessly throughout most of last week, rallied strongly at the beginning of this week on the announcement that the four US copper producers in Chile have responded favourably to the Chilean Government's recommendation that production be cut back by 10 per cent. This projected cutback, along with the Phelps-Dodge reduction in output announced last week and those already in force, will, it is now generally believed, bring production in line with consumption. While it is difficult to be dogmatic in such matters as the production and consumption of copper, it may well be that the present situation will see equilibrium established at too low a level to support much in the way of a revival of demand. If this interpretation is right any apparent expansion in buying will soon reflect itself in higher prices for copper.

In the US, the custom smelters—as expected—lowered their price last week by a further ½ cent to 24 cents a pound. Before the London copper price rallied this week on the above outlined considerations, the lowered quotation of the US smelters contrived to knock the LME quotation down to around £160 a ton.

Tin has been very much in the limelight during the past week. The International Tin Council showed its teeth in a very convincing manner and the three months' price has responded accordingly. Briefly, the International Tin Council has extended the present export quota restrictions to March 31 instead of March 14 and has applied these restrictions to a second period called April 1 to June 30. This means that the overall reduction in exports by the six producing countries involved is now as much as 40 per cent. of their annual rate of output. Through the extended period, the buffer stock manager will continue to have the right to sell tin at £781 a ton, although he is not compelled to sell the metal until the quotation reaches £880 a ton. The communiqué issued by the council also settled the rumour about the third contribution, as it announced that it has been called up on December 31, 1957, and that most of it had already been paid in advance in cash. Finally, the council reflected its determination to bring production and consumption into line by divulging that the delegates had unanimously recommended to their respective governments the creating of a special fund to place at the disposal of the buffer stock manager. These considerations banished market doubts as to the probable future course of the three months' price and the three months' quotation closed on Monday only £1 below the cash price, which showed a small premium over the floor price of £730 a ton. Despite the hardships on marginal mines which this scheme will inflict, there is little doubt that tin metal available for cash is going to become scarce quickly and that any suspicion of demand will soon put the three months' quotation up to £780 a ton. Indeed, there must now be a strong disposition on the part of producers to sit on their stocks until the price does advance to that point or higher. In the US the price advanced to around 94 cents a pound.

Lead is a better market. This stems mainly from the fact that at present price levels it is uneconomic to ship raw materials, so that lead metal is once more flowing across the Atlantic.

Stop Press!

IN THE PARAGRAPH about the Cocktail Party of the South of England Ironfounders' Association, printed on page 114 of this issue of the JOURNAL, it should have been made clear that the guests were received by Mr. A. R. Wizard, the present chairman. Mr. M. J. Glenny was on this occasion a guest.

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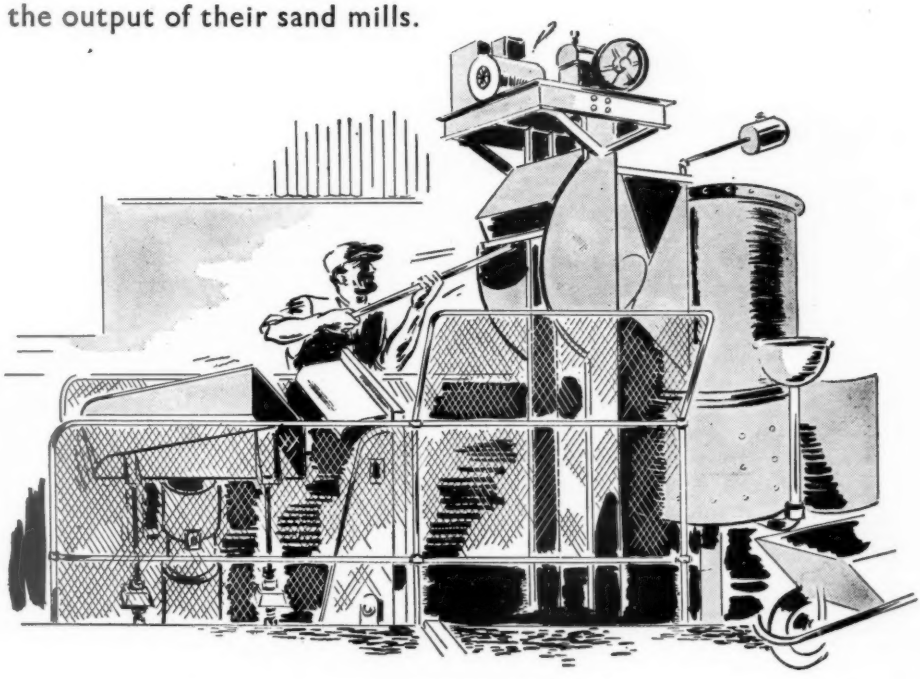

For service and information write to:

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Patteson Court, Nutfield Road, Redhill, Surrey

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CMF 13

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

January 29, 1958

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S.1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £48 10s. 0d. to £50 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £68 10s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 27s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 8s. 5d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 11s. 5d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £93 0s. 0d. to £96 10s. 0d., basis 60 per cent. Cr, scale 32s. 0d. per unit; over 6 per cent. C, £91 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 32s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10¼d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 20s. 9d. to 21s. 3d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles (N.-E. Coast), £40 6s. 6d.; joists (N.-E. Coast), £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24g., £59 4s. 6d.; galvanized corrugated sheets, 24g., £67 13s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d.; nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £163 15s. 0d. to £164 0s. 0d.; three months, £165 15s. 0d. to £166 0s. 0d.; settlement, £164 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 7d. per lb. rods, 185s. 9d. per cwt. basis; 20 s.w.g., 219s. 0d. per cwt.

Tin.—Cash, £732 10s. 0d. to £733 0s. 0d.; three months, £732 0s. 0d. to £732 10s. 0d.; settlement, £733 0s. 0d.

Lead (Refined Pig).—Second half January, £72 2s. 6d. to £72 5s. 0d.; second half April, £72 17s. 6d. to £73 0s. 0d.

Zinc.—Second half January, £63 10s. 0d. to £63 15s. 0d.; second half April, £62 15s. 0d. to £63 0s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £95 10s. 0d.; rolled zinc (boiler plates), all English destinations, £97 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £95 0s. 0d.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 4d. per lb.; sheets to 10 w.g., 144s. 6d. per cwt.; wire, 2s. 1⅞d.; rolled metal, 144s. 6d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £128; B6 (85/15), —; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £174; HTB2 (38 tons), —; HTB3 (48 tons), —.

Gunmetal.—BS1400, LG2 (85/5/5/5), £157; LG3 (86/7/5/2), £167; G1 (88/10/2/½), £220; (88/10/2/1), £209.

Phosphor Bronze.—BS1400, PB1 (AID released), — per ton.

Phosphor Bronze Strip, etc.—Strip, 214s. 6d. per cwt.; wire, 3s. 4⅜d. per lb.; rods, 2s. 8¼d.; tubes, 2s. 8¼d.; chill cast bars: solids 2s. 10½d.; cored 2s. 11½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 3¾d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 8½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 7½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £73 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £197; AB2, £210.

* Average 68-70 per cent.